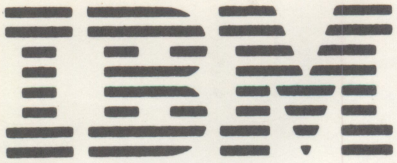
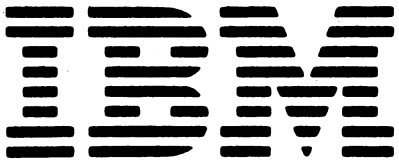


SY09-1013-0

MAINTENANCE INFORMATION

IBM 5255 Display Station
Model 2
Maintenance Information Manual



SY09-1013-0

MAINTENANCE INFORMATION

IBM 5255 Display Station
Model 2
Maintenance Information Manual

First Edition (October 1980)

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Preface

This maintenance information manual is to be used for servicing the IBM 5255 Model 2 Display Station. Customer engineers using this manual are assumed to have completed the courses on the 5251 Models 1 and 11 and 5255 Display Stations.

The maintenance information manual (MIM) has two major sections: maintenance and theory. Maintenance includes locations, procedures, and diagnostic aids. Theory includes data flow, functional units, and features.

Definitions of terms and abbreviations that are not common, but are used in the MIM, are in the *Glossary of Terms and Abbreviations.*

Setup instructions for the 5255 Display Station are in *Appendix A.*

Note: MIM pages iv, 1-4, 1-5, 1-7, 1-32, 1-33, 1-35, 1-60, 1-61, 1-62, 1-63, 1-64, 1-65, 1-71, 1-74, 1-77, 1-78, 1-85, 1-86, 1-91, 1-92, 3-2, and A-1 have DANGER and/or CAUTION notices. If desired, translate these notices and write your own words on the blank lines provided on these pages.

Related Publications

Related information can be found in the following IBM 5250 Information Display System manuals:

- *IBM 5255 Display Station, Parts Catalog,* S131-1003
- *IBM 5250 Information Display System Reference Card,* GX21-9249
- *IBM 5255 Display Station Model 2, Operator's Guide,* GA09-1626
- *IBM 5251 Models 1 and 11, IBM 5252 Display Station Operator's Guide,* GA21-9248
- *IBM 5255 Display Station Model 1, Maintenance Analysis Procedures,* SY09-1012
- *IBM 5251 Display Station Models 1 and 11 Maintenance Information Manual,* SY31-0461
- *IBM 5251 Display Station Models 1 and 11 Maintenance Analysis Procedures,* SY31-0571
- *IBM 5252 Dual Display Station Maintenance Information Manual,* SY31-0492
- *IBM 5252 Dual Display Station Maintenance Analysis Procedures,* SY31-0584
- *IBM 5250 Information Display System Planning and Site Preparation Guide,* GA09-1622

Safety

The 5255 Display Station has the following specific DANGERs:

- Line voltage is present at the power supply and the display assembly.

- High voltage is present at the cathode-ray tube.

- The cathode-ray tube could implode if it is hit or if it falls.

- The green wire in the display assembly is not at ground voltage.

CE SAFETY PRACTICES

All Customer Engineers are expected to take every safety precaution possible and observe the following safety practices while maintaining IBM equipment:

1. You should not work alone under hazardous conditions or around equipment with dangerous voltage. Always advise your manager if you MUST work alone.
2. Remove all power, ac and dc, when removing or assembling major components, working in immediate areas of power supplies, performing mechanical inspection of power supplies, or installing changes in machine circuitry.
3. After turning off wall box power switch, lock it in the Off position or tag it with a "Do Not Operate" tag, Form 229-1266. Pull power supply cord whenever possible.
4. When it is absolutely necessary to work on equipment having exposed operating mechanical parts or exposed live electrical circuitry anywhere in the machine, observe the following precautions:
   a. Another person familiar with power off controls must be in immediate vicinity.
   b. Do not wear rings, wrist watches, chains, bracelets, or metal cuff links.
   c. Use only insulated pliers and screwdrivers.
   d. Keep one hand in pocket.
   e. When using test instruments, be certain that controls are set correctly and that insulated probes of proper capacity are used.
   f. Avoid contacting ground potential (metal floor strips, machine frames, etc.). Use suitable rubber mats, purchased locally if necessary.
5. Wear safety glasses when:
   a. Using a hammer to drive pins, riveting, staking, etc.
   b. Power or hand drilling, reaming, grinding, etc.
   c. Using spring hooks, attaching springs.
   d. Soldering, wire cutting, removing steel bands.
   e. Cleaning parts with solvents, sprays, cleaners, chemicals, etc.
   f. Performing any other work that may be hazardous to your eyes. REMEMBER – THEY ARE YOUR EYES.
6. Follow special safety instructions when performing specialized tasks, such as handling cathode ray tubes and extremely high voltages. These instructions are outlined in CEMs and the safety portion of the maintenance manuals.
7. Do not use solvents, chemicals, greases, or oils that have not been approved by IBM.
8. Avoid using tools or test equipment that have not been approved by IBM.
9. Replace worn or broken tools and test equipment.
10. Lift by standing or pushing up with stronger leg muscles – this takes strain off back muscles. Do not lift any equipment or parts weighing over 60 pounds.
11. After maintenance, restore all safety devices, such as guards, shields, signs, and grounding wires.
12. Each Customer Engineer is responsible to be certain that no action on his part renders products unsafe or exposes customer personnel to hazards.
13. Place removed machine covers in a safe out-of-the-way place where no one can trip over them.
14. Ensure that all machine covers are in place before returning machine to customer.
15. Always place CE tool kit away from walk areas where no one can trip over it; for example, under desk or table.
16. Avoid touching moving mechanical parts when lubricating, checking for play, etc.
17. When using stroboscope, do not touch ANYTHING – it may be moving.
18. Avoid wearing loose clothing that may be caught in machinery. Shirt sleeves must be left buttoned or rolled above the elbow.
19. Ties must be tucked in shirt or have a tie clasp (preferably nonconductive) approximately 3 inches from end. Tie chains are not recommended.
20. Before starting equipment, make certain fellow CEs and customer personnel are not in a hazardous position.
21. Maintain good housekeeping in area of machine while performing and after completing maintenance.

Knowing safety rules is not enough.
An unsafe act will inevitably lead to an accident.
Use good judgment - eliminate unsafe acts.

ARTIFICIAL RESPIRATION

General Considerations

1. Start Immediately – Seconds Count
   Do not move victim unless absolutely necessary to remove from danger. Do not wait or look for help or stop to loosen clothing, warm the victim, or apply stimulants.
2. Check Mouth for Obstructions
   Remove foreign objects. Pull tongue forward.
3. Loosen Clothing – Keep Victim Warm
   Take care of these items after victim is breathing by himself or when help is available.
4. Remain in Position
   After victim revives, be ready to resume respiration if necessary.
5. Call a Doctor
   Have someone summon medical aid.
6. Don't Give Up
   Continue without interruption until victim is breathing without help or is certainly dead.

Rescue Breathing for Adults

1. Place victim on his back immediately.
2. Clear throat of water, food, or foreign matter.
3. Tilt head back to open air passage.
4. Lift jaw up to keep tongue out of air passage.
5. Pinch nostrils to prevent air leakage when you blow.
6. Blow until you see chest rise.
7. Remove your lips and allow lungs to empty.
8. Listen for snoring and gurglings – signs of throat obstruction.
9. Repeat mouth to mouth breathing 10-20 times a minute. Continue rescue breathing until victim breathes for himself.

Thumb and finger positions

Final mouth-to-mouth position

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Glossary of Terms and Abbreviations

μf: Microfarad.

activity: Action or process.

addr: Address.

alpha: Alphabetic.

alternate entry: An alternative means of entering ideographic characters of a language. All ideographic characters defined to the system can be entered on the ideographic keyboard by pressing sequences of special numeric keys.

ALU: Arithmetic logic unit.

amplifier: A device that increases a voltage or a signal to a usable level.

A/N: Abbreviation for *alphanumeric.*

anode: A positive terminal.

arithmetic: The adding, subtracting, multiplying, or dividing of two or more numbers.

attribute: A characteristic that controls how data is displayed on the display screen. For example, the attributes of a display field include blinking, high intensity, and reverse image.

blank display: No characters or other screen image of any kind (including cursor and display screen indicators).

blink attribute: An attribute of a display field that causes the characters to flash.

brightness limiter potentiometer: A potentiometer that prevents too much brightness. See reference 150.

buffer: A temporary storage area.

Cable Thru feature: A special feature that permits multiple display stations or printers to be attached serially to a system cable.

callout: A character used to identify a particular portion of an illustration.

capacitive: Having capacitance.

cathode: A negative terminal of a diode.

char: Character.

character matrix: A part of the display screen character window. The 5255 character matrix is 16 dots high by 8 dots wide for A/N characters. The ideographic character matrix is 18 dots high by 18 dots wide.

character window: The area of the display screen within which a character is displayed.

clicker: A solenoid in the keyboard that makes a sound after each keyboard character has been received by the display station.

CMD key: The command key on the keyboard that is used to select command functions.

column separator: A vertical bar in a field of data that separates all characters in that field.

command function keys: The 14 keys on the top row of the display station keyboard that are used with the CMD (command) key to request functions.

cont: Controller.

contrast control: The device that changes the contrast. See reference 100.

controller: A device that controls the operation of one or more input or output devices.

data stream: A continuing flow of data.

diag: Diagnostic.

driver: A source that sends (drives) a signal from one location to another. See reference 212.

dual: Having two similar parts.

DUP key: The key on the keyboard that is used to duplicate a field from a preceding field.

EOM: End of message.

end-of-message delimiter: A 111 in the station ID field that indicates the last frame of a message block.

EOQ: End of queue.

ERAP: Error recording analysis procedures.

extended character: An ideographic character that is not contained in the permanent character generator hardware of the 5255 Display Station.

field attribute: The control characters that describe a displayed field. For example, a display field can be intensified, reversed, underscored, or made to blink.

flyplate: The bottom of a key module.

FRU: Field-replaceable unit.

hex: Hexadecimal.

HH:MM:SS: Hours, minutes, and seconds.

ID: Identification.

IDEO/ALT key: A key on the ideographic keyboard that is pressed to select 2-byte data entry modes.

ideographic: Having to do with characters composed of pictograms or graphics that represent ideas. Ideographic languages, of which Chinese and Japanese are examples, usually contain a large number of ideographic characters. Each ideographic character requires two bytes of data. See also *2-byte character.*

ideographic either field: A field specified as *either* allows the operator to set or change modes (1-byte A/N or 2-byte ideographic) when the cursor is in the first input position of the field. An *either* field may contain all ideographic or all alphanumeric characters, but not both.

ideographic keyboard: A large keyboard containing 216 data keys with multiple character choices (12) for each key, 21 function keys, 12 shift keys that are used together with data keys (ideographic mode) or in sequences for entering extended characters (alternate entry mode), two mode-selection keys, and one each of the following keys: alternate shift/mode selection, enter, reset, and spacebar.

ideographic mode: 2-byte entry mode of the ideographic keyboard that uses a shift-and-data key combination for each entry.

ideographic only field: A field specified as *ideographic only* accepts only 2-byte data characters.

ideographic open field: A field that is specified as *open* allows the operator to set or change modes (1-byte A/N or 2-byte ideographic) anywhere within the field. A mixture of alphanumeric and ideographic subfields in an *open* field is thus possible in response to command-key-and-mode-key sequences.

implode: To break inward suddenly.

INS key: The key on the keyboard that is used to select the insert mode.

IPL: Initial program load.

kbd: Keyboard

key stem: The connecting part between the keytop and the key module.

Keylock feature: A feature with a lock and key that restricts the use of the display station.

keystroke: The action of pressing a key on the keyboard.

LED: Light-emitting diode.

linearity: The size of displayed characters of equal width.

line turnaround: The time between the reception of the last bit of a frame by a work station and the start of transmission by that same work station.

LRC: Longitudinal redundancy check.

make/break key: A key that generates a scan code when the key is pressed and when it is released.

mandatory: Something that must be done or must be present.

menu: A list of options that can be selected.

microfarad: One millionth part of a farad.

microinstruction: A basic or elementary machine instruction.

microprocessing: Operations performed by the MPU.

microprocessing unit (MPU): A processing unit that is microprogram controlled and performs internal machine operations. The MPU receives data, controls the display of data, and controls the flow of information to and from the controller.

microprogram: A program that uses microinstructions to carry out system operations.

mini-MAP: A maintenance analysis procedure that is located in the maintenance information manual. A mini-MAP continues the failure analysis after one of the other MAPs has located the area that is failing.

MPU: Microprocessing unit.

MSR: Magnetic Stripe Reader feature.

mm: Millimeter.

ms: Millisecond.

msg: Message.

MSIPL: Main storage initial program load.

multiframe response: More than one frame of data is being sent.

N/C: Pertains to a switch setting; normally closed.

N/O: Pertains to a switch setting; normally open.

null: A hex character composed of all zeros; this character occupies a position in the buffer and is displayed as a blank.

online test: A series of tests that can be requested from the system after power on and before sign-on. See reference 206.

option: One of the items listed on a display screen menu.

overview: A short description.

P-P: Peak-to-peak.

PC: Printed circuit.

phonetic: Having to do with pronunciation and sound-symbols.

planar: A printed circuit electronic board used in the display station.

PM: Preventive maintenance.

poll: A method the controller uses to determine if a display station is ready to send or receive data.

POR: Power-on reset.

port: The place where a cable is connected to a machine.

protector: A device that aids in preventing injuries to persons or damage to machines.

R/D: Receiver/driver.

RAM: Extended display-character storage area of the 5255 Display Station for 2-byte-character dot data not stored in ROS.

raster: The image on the CRT that is made by the action of the CRT electron beam as it scans across the area of the CRT where data is displayed. Normally, the intensity of the raster is not high enough to be visible; however, the raster can be displayed if you install a raster check jumper.

read-only storage (ROS): A storage area in the MPU from which data can be read but not changed.

read/write storage: A storage area in the MPU that stores information for later use; the information can be changed by the MPU.

receivers: Those parts that accept data or voltages.

refresh: To continuously redisplay data on the display screen to prevent the data from fading out; the display adapter refreshes the data.

regen buffer: An area in read/write storage where data is stored before it is displayed.

register: A storage device or circuit that stores those limited parts of data needed by the system to execute input/output, storage, processing, and control operations.

related: Having a common use.

required: See mandatory.

resolution: The visual quality of display screen data.

retaining ears: The projections located on the bottom of a key module; these projections hold the module to the frame. See reference 133.

retrace lines: The lines that appear on the display screen when the display adapter returns the sweep to the upper left corner of the display screen. Retrace lines are normally blanked out. See reference 156.

retry: To repeatedly send frames of information until the frames are received without an error by the display station; the controller sends the frames.

ripple: Small waves present on dc voltages.

ripple level: A measurement of the ac voltage carried on the dc voltage.

rolling: Pertains to movement on a display screen; the movement can be either horizontal, vertical, or a combination of both.

ROS: Read-only storage.

rt adj: Right adjust.

serdes: Serializer/deserializer.

serializer/deserializer (serdes): A register that is used to send and receive data between the display station and the controller.

setup: To prepare a device for operation.

shift-in character: A control character that signals the end of ideographic data.

shift-out character: A control character that signals the start of ideographic data.

SI: Abbreviation for *shift-in.*

sign-on: A logon procedure performed at a display station; the procedure can include entering the sign-on command, a password, or other user-specified security information.

slot: A narrow opening or groove.

SO: Abbreviation for *shift-out.*

SOM: Start of message.

stabilizer: A rod on the Spacebar. See reference 134.

stat addr: Station address.

stem: See *key stem.*

stiffener: A part used to supply rigidity to a logic card or planar.

storm: Electrical discharges in the air.

strain relief cable: A cable that supports the planar.

SVCS: Services.

SYS: System.

SYS REQ key: A key that is used to send a request directly to the system.

taper: Decreasing in size toward one end.

TB: Terminal block.

terminator switch: A switch used to terminate the customer system cable at the last display station or printer in a series. This switch is a part of the Cable Thru feature on a display station.

theory: A section of this manual that includes data flow, functional units, and features.

transfer: To move from one person, place, or thing to another.

twinaxial cable: A shielded twisted-pair cable that connects a display station or printer to a controller.

typamatic key: A repeat-action key on the keyboard.

undefined: The meaning is not known or described.

underscore: A line under all positions of a field. Underscore is controlled by an attribute.

US: United States.

Vac: Volts alternating current.

Vdc: Volts direct current.

verification: Testing an operation or machine.

video: Pertains to the display screen image.

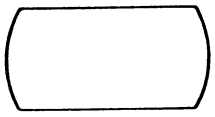
YY/MM/DD: Year, month, and day.

1-byte character: A character entered in alphanumeric mode is represented by one byte (two hexadecimal characters).

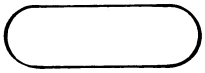
2-byte character: A Character entered in ideographic mode is represented by two bytes (four hexadecimal characters).

Legend

The following symbols may be used in flowcharts and figures throughout this manual.



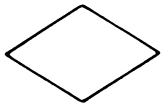
Display Screen



Start and End of Flowchart

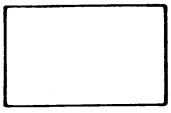
Off-Page Connector

On-Page Connector

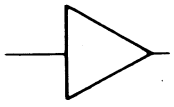


Decision Block

Comment Block

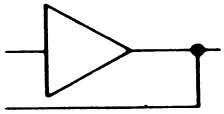


Information Block



Logic (indicates signal direction)

Driver



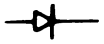
Logic

Driver/Receiver

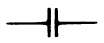
Relay Driver

Detector

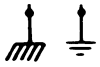
Zener Diode



Diode



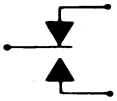
Capacitor



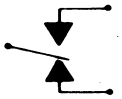
Ground

Transformer

Relay



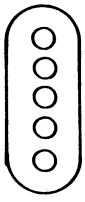
Contact (relay not energized)



Contact (relay energized)

Resistor

Jumper



Control Panel Lights

Using the IBM 5255 Display Station Maintenance Information Manual

The information in this MIM is to be used as reference material when you are diagnosing machine failures. This MIM contains a *Maintenance Procedures* section, a *Preventive Maintenance* section, a *Tools and Test Equipment* section, a *Theory* section and a *Features* section. Appendixes give general information (such as setup procedures) that is not directly related to the maintenance of the 5255 Display Station.

The format for page numbering is X-YYY.Z. X is the section number. YYY is the page number, and Z (although not normally used) is the number used for expansion when it is not practical to give new numbers to all pages.

Three-digit reference numbers are assigned to location drawings and maintenance procedures that are referred to in the MAPs. For example, 130 indicates the keyboard locations of the display station.

MAINTENANCE PROCEDURES SECTION

The *Maintenance Procedures* section contains location drawings, maintenance procedures, mini-MAPs, and diagnostic aids for repairing, installing, or diagnosing the failing FRUs (field-replaceable units).

Location Drawings

Location drawings show the position of the parts in the display station.

Maintenance Procedures

Maintenance procedures contain removal, replacement, and adjustment procedures. All procedures and drawings have three-digit reference numbers.

Mini-MAPs

You are sent to mini-MAPs to continue the failure analysis to locate a failing field-replaceable unit.

In general, mini-MAPs provide you with three levels of information:

1. A figure showing the circuit line names and pin numbers.
2. A description of the circuit and how it can be tested.
3. A detailed guide that uses the yes and no path of questions that you can follow to isolate the failure.

You can select the level of information you need to locate a failing field-replaceable unit.

Diagnostic Aids

Diagnostic Aids describe diagnostic programs, how to use them, and what is available when they are in control. To aid in diagnosing machine failures in more detail, a list of error conditions is included.

PREVENTIVE MAINTENANCE SECTION

The *Preventive Maintenance* section describes any preventive maintenance required by the display station.

TOOLS AND TEST EQUIPMENT SECTION

The *Tools and Test Equipment* section describes the tools that are needed to service the display station.

THEORY SECTION

The *Theory* section describes the functional units and features. These descriptions are preceded by a view of the system that gives you a general idea of the complete operation and how each function or feature relates to the operation.

FEATURES SECTION

The *Features* section describes the features that are available with the 5255 Display Station.

APPENDIXES

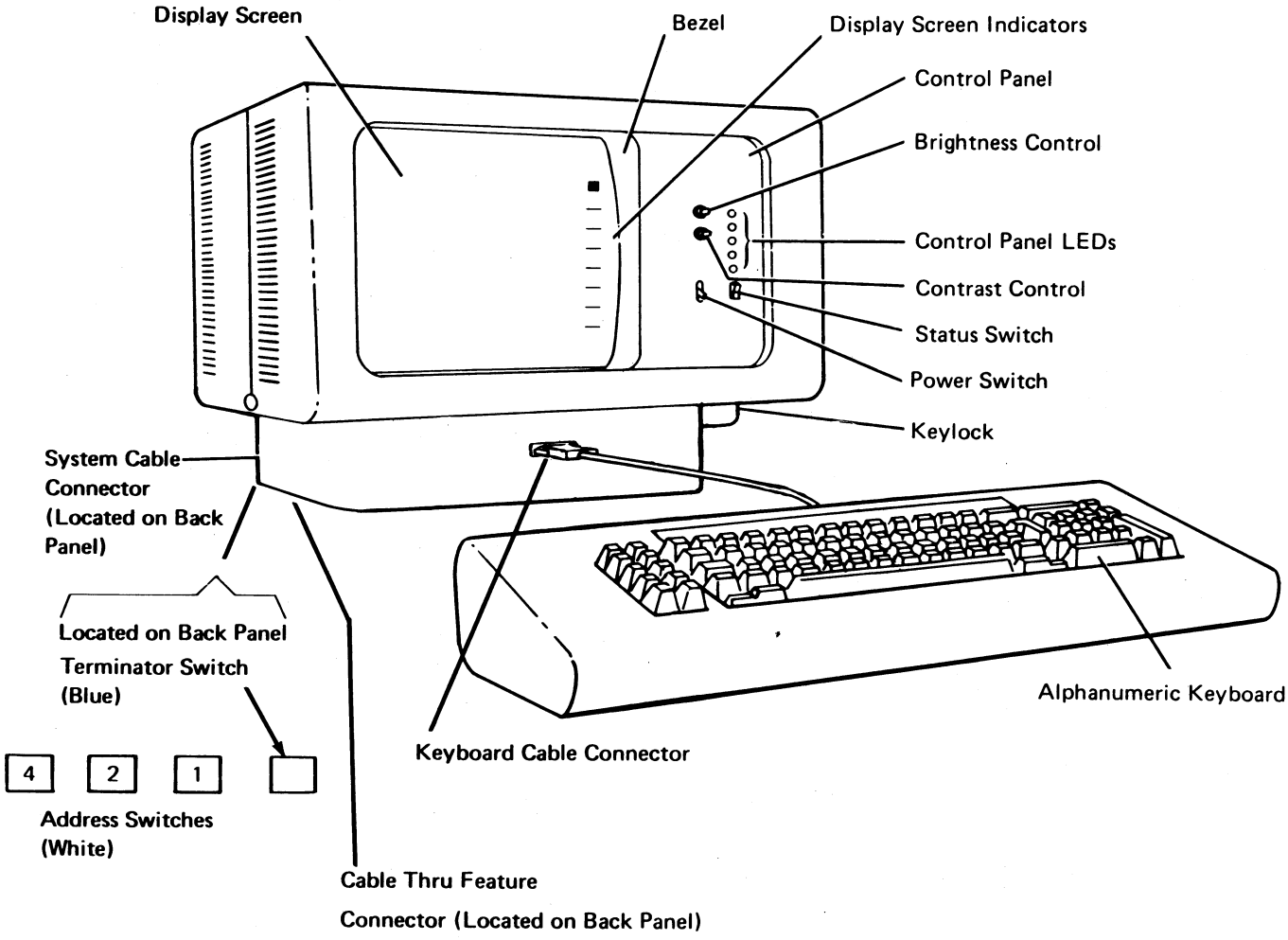
Appendix A contains the setup procedures required to make a new display station operational. Appendix B explains the purpose of special keys on the keyboards. Appendix C explains the operation of the Self-Check feature. Self-Check is a host system feature.

INDEX

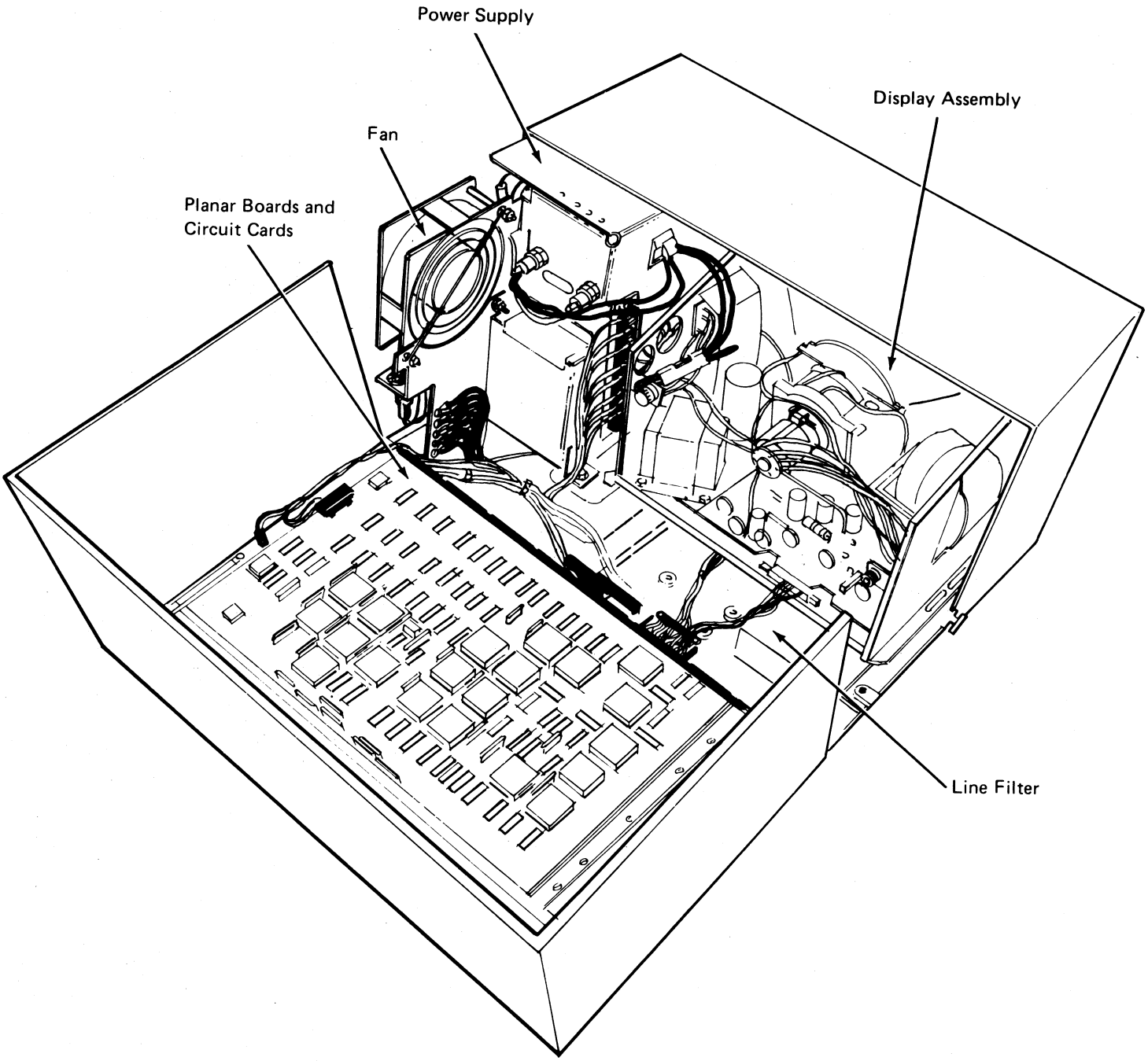
The index is a detailed list of all the material contained in the MIM.

Locations

100 FRONT VIEW

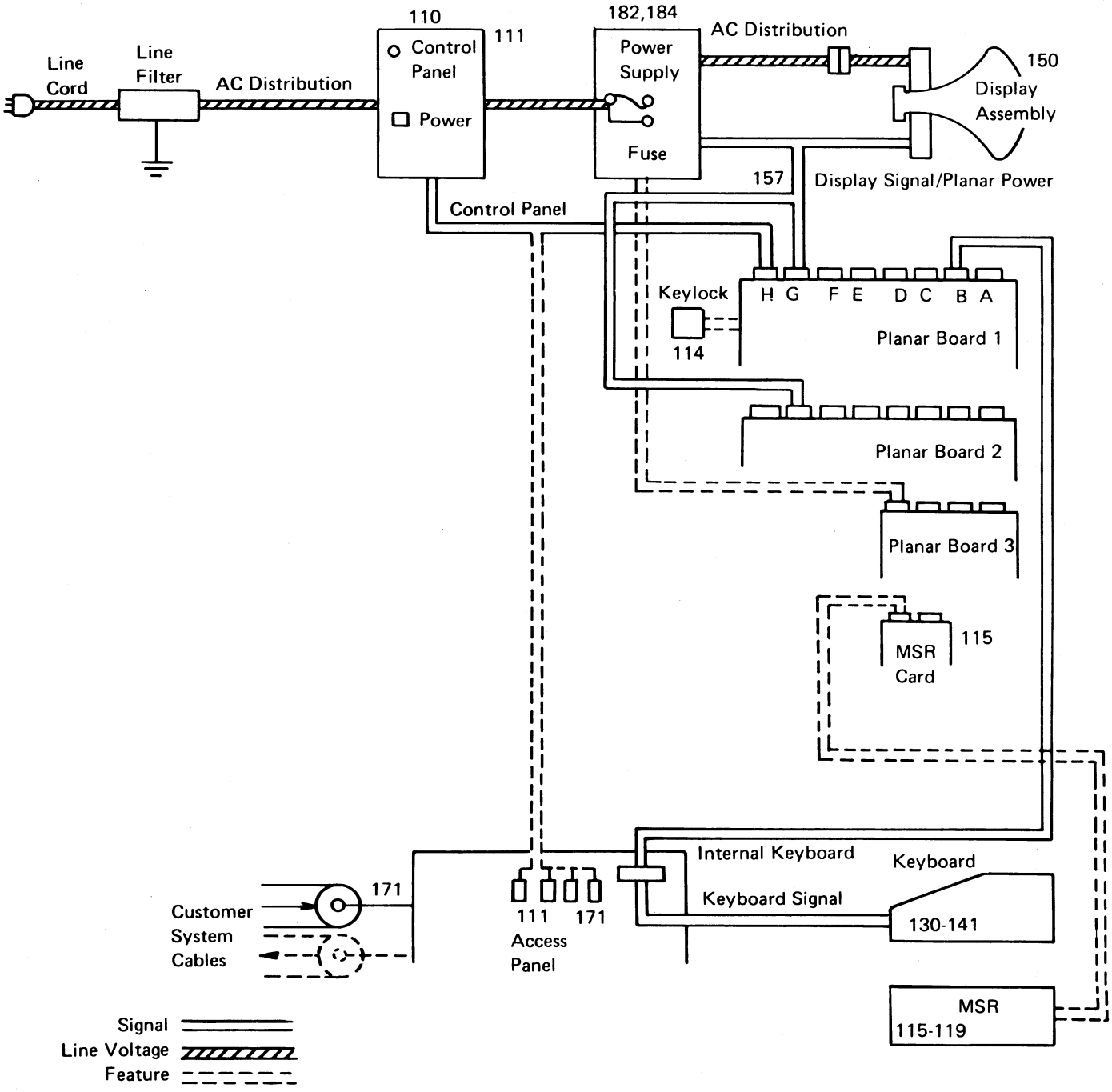


101 COVERS OPEN



102 CABLE CHART

The numbers shown on the chart indicate the section in the MIM where detailed information about cables for that portion of the chart is located.



103 PLANAR BOARDS AND CARD LOCATIONS

CAUTION

- Ground is not always D08.

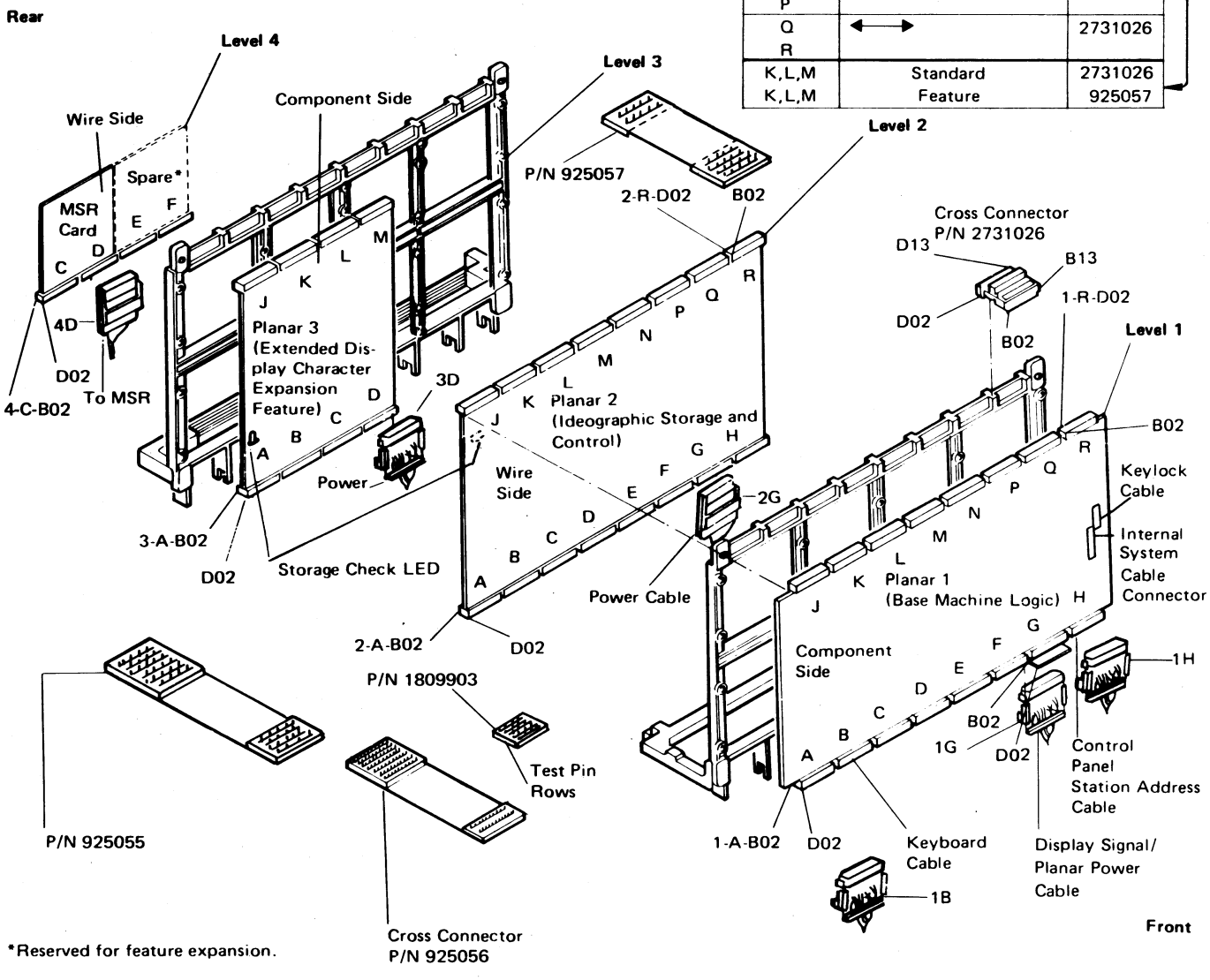
- Do not remove cables, connectors, or planars with the machine powered on.

Cross-connector Locations

Feature ◄- - - - - - - ►

Standard ◄——————►

Socket	Level 1	2	3	4	Crossover P/N
A		◄- - - ►			925056
B		◄- - - ►			925056
C	◄- - - - - - - - - - - - ►				925055
D	◄——►				1809903
E					
F					
J	◄- - - - - - - ►				925057
K	◄—— - - ►				see below
L	◄—— - - ►				see below
M	◄—— - - ►				see below
N					
P					
Q	◄——►				2731026
R					
K,L,M	Standard				2731026
K,L,M	Feature				925057



*Reserved for feature expansion.

104 LOGIC PART NUMBERS

CAUTION
The logic used on planar boards can be damaged by an electrostatic discharge. Prevent any contact with conductors. Handle planars by the plastic frame only.

Discharge yourself and the plastic container containing the new planar by holding the bag and momentarily touching the machine frame.

Ensure that the wire side is face down when placing a planar on any surface.

The MSR feature card part number is 2767396.

Without Country Jumpers:

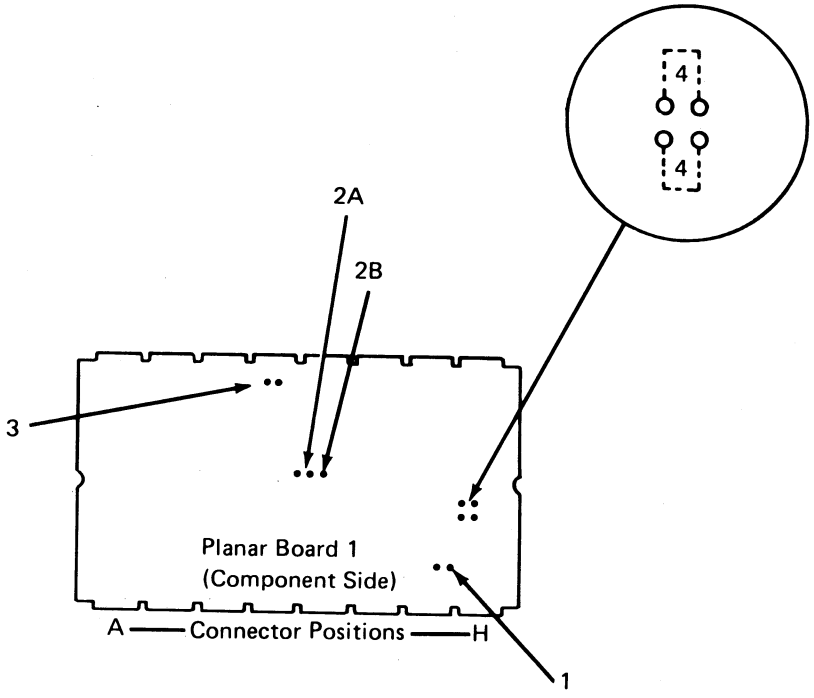
Description	Planar Board Part Numbers 5255-2
Planar 1	925 232
Planar 2	925 209
Planar 3	925 188

105 PLANAR BOARD 1 JUMPERS

The jumper part number is 1794401.

Jumper Position	Description
1	Display raster (Installed for raster verification only)
2A	Installed for base machine; not present for Extended Display Character Expansion feature
2B	Installed for Extended Display Character Expansion feature; not present for base machine
3	Stop on storage check (Installed during failure diagnosis only)
4	Installed (both jumpers) when the Cable Thru feature is *not* installed

Jumper (part 1794401)



Covers

108 DISPLAY STATION COVERS

CAUTION
Place the display station away from the edge of the table to prevent damage to the covers.

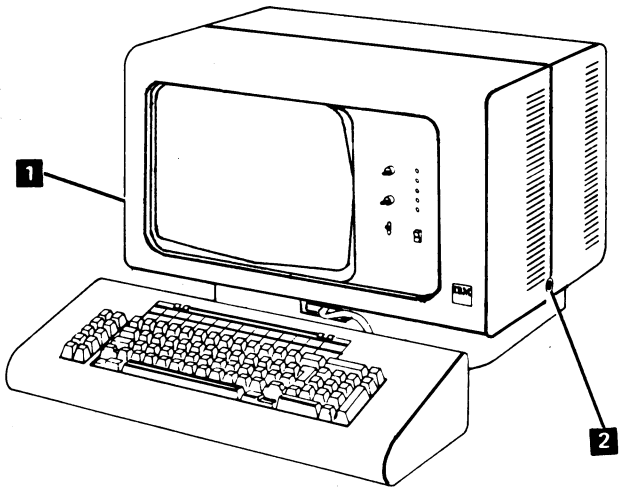
To open the covers:

1. Loosen the screw 1 on the left side of the display station.
2. Loosen the screw 2 on the right side of the display station.
3. Hold the front half of the cover and pivot it toward the front of the display station.
4. Hold the back half of the cover and pivot it toward the back of the display station.

CAUTION
When closing the covers, ensure that the screw fits over the lip of the cover to prevent damage to the cover and to ensure that the cover is tightly fastened down.

To close the covers:

1. Pivot the front half of the cover toward the back of the display station.
2. Pivot the back half of the cover toward the front of the display station.
3. Tighten screws 1 and 2 . Ensure that the screws fit over the lip of the cover.



109 KEYBOARD COVERS

Alphanumeric Keyboard Cover

Removal

1. Loosen the four screws on the bottom of the keyboard assembly.
2. Lift the cover away from the keyboard.

Replacement

1. Place the cover on the keyboard assembly.
2. Tighten the four screws on the bottom of the keyboard assembly.

Note: Ensure that the keys do not rub on the cover.

Ideographic Keyboard Cover

Removal (See Illustration in 131)

1. Tip up the front of the ideographic keyboard and remove the three holding screws on the underside of the front edge of the cover.

2. Lower the keyboard; at the back of the keyboard cover, remove the four holding screws; two of these screws are at the corners and the other two are on each side of the keyboard cable.

Replacement

1. Align the back edge of the cover and lower the front of the cover over the keys.

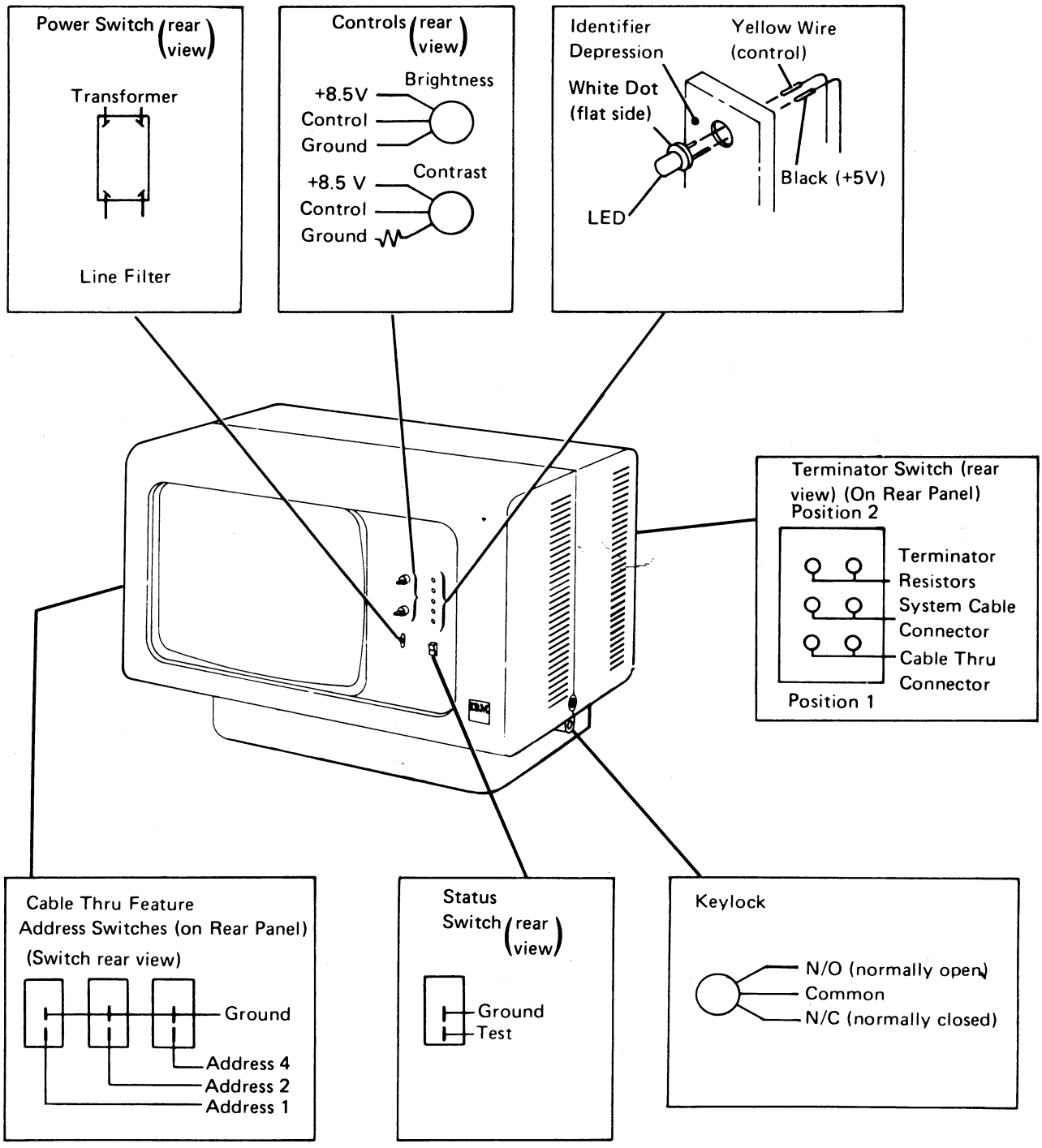
2. Ensure that the strain relief for the keyboard cable is in place; insert and tighten the four screws at the back of the keyboard.

3. Inspect for keys binding against the cover cutouts. If this occurs, remove the top cover again, loosen the keyboard assembly mounting screws, shift the keyboard assembly, and tighten the mounting screws again.

4. Tip up the front of the keyboard and replace the three holding screws on the underside of the front edge of the top cover.

Control Panel, Rear Panel, and Keylock

110 CONTROL PANEL



111 CONTROL PANEL CABLE MINI-MAP

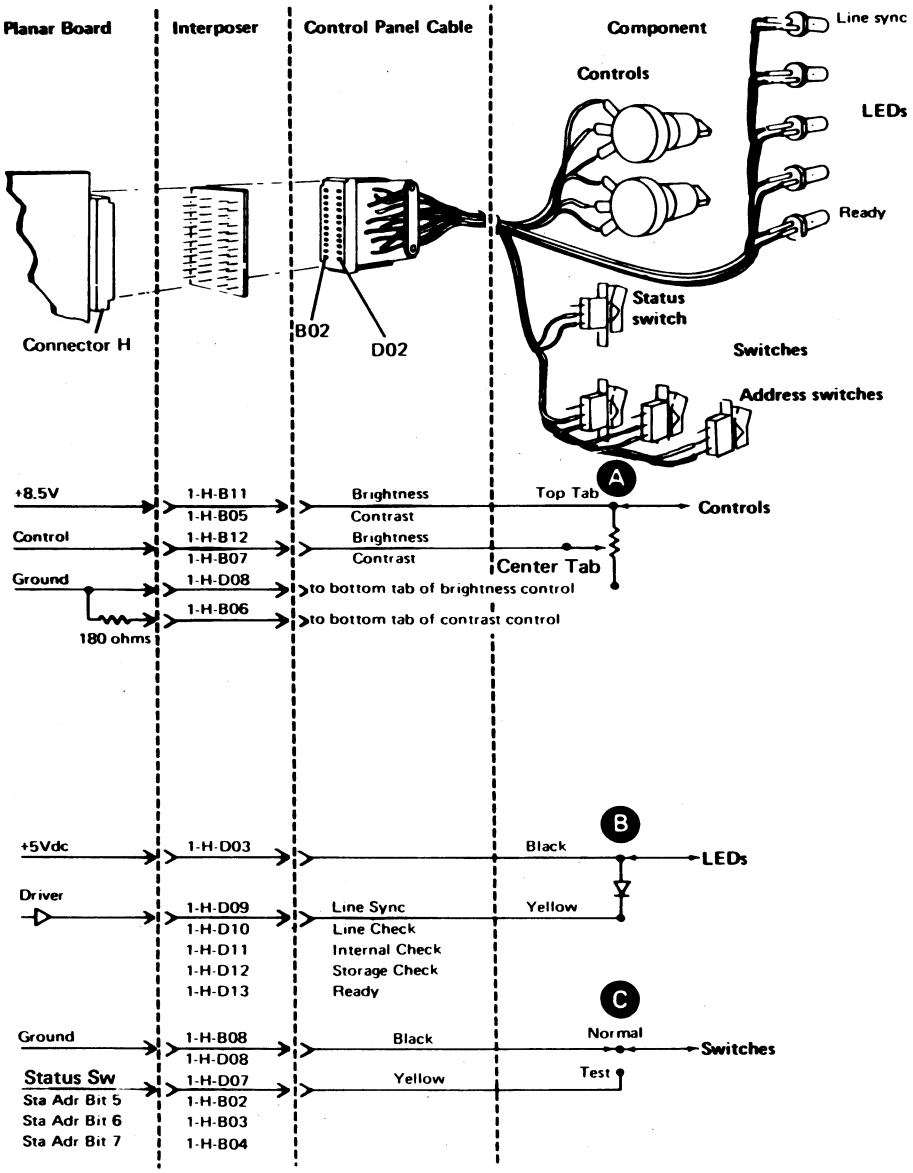
- For mini-MAP example, see Troubleshooting Aids (212).

Conditions after power on

- **All voltages are active.**
- **When a switch is closed the line is a down level and displayed as a 1 bit.**

Service Aids

- Do not ground an LED line:
  Planar or LED damage will result.
- LEDs may be swapped to isolate the failure.
- Do not change the setting of the address switches when the power switch is on.



111 (continued)

Check the voltages and grounds.

1-H-B11 (+8.5V)
1-H-B08 (GND) or down light on probe.
1-H-D08 (GND) or down light on probe.
1-H-D03 (+5V)

Are the conditions normal?
Y N

- Inspect the interposer;
- Replace planar 1. (103, 105)

- Power off.
- Refer to the diagram and select the failing circuit A or B or C.
- Remove cable at planar 1.
- Using an ohmmeter, measure the resistance of A or B or C, then answer the questions below. (Also measure the resistance of lines to frame ground).

Are the conditions normal?
Y N

- Trace the conditions to the device component (see circuit).
- Repair or replace the cable or replace the device component.

- Verify address switches set correctly. If OK, inspect the interposer; check the jumpers, replace planar 1 (103, 105) and verify the fix. If the failure continues, replace planar 2.

Suggested action for an intermittent problem:

- Analyze the suspected line; inspect all the connector contacts.

- Replacement sequence:
  - Device component
  - Planar
  - Control panel logic cable

(A)

Brightness control

1-H-B11 to 1-H-D08 (100 ohms)
1-H-B11 to 1-H-B12 (CCW CW)

Contrast control

1-H-B11 to 1-H-B06 (350 ohms)
1-H-B11 to 1-H-B07 (0–350)

(B)

LED check (see circuit for pins)

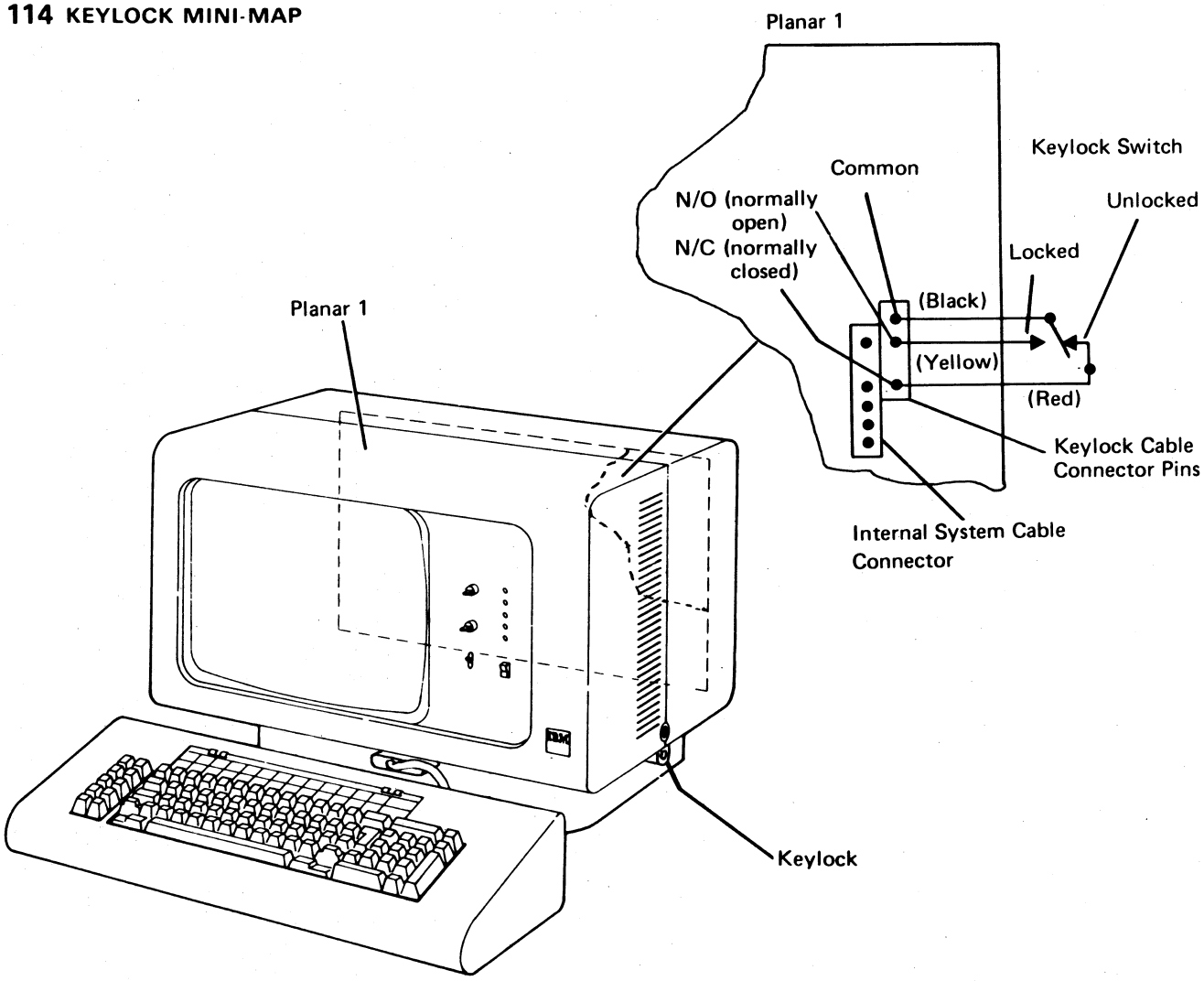
1-H-D03 to 1-H-DXX
FWD Ω = 4K
REV Ω = 10K

(C)

Switch check (see circuit for pins)

1-H-D08 to 1-H-XXX
Switch open = ∞
Switches closed = less than 1 ohm

114 KEYLOCK MINI-MAP



114 (continued)

- Remove the connector from the planar.
- Use a CE meter.
- Check continuity at the planar end of the cable between the common and the normally open lines with the switch in the locked position.

Is there continuity?

Y **N**

- Repair or replace the keylock assembly.

- Check continuity at the planar end of the cable between the normally open and the normally closed lines with the switch in the locked position.

Does the meter indicate an open circuit?

Y **N**

- Repair or replace the keylock assembly.

- Check continuity at the planar end of the cable between the normally closed and the common lines with the switch in the unlocked position.

Is there continuity?

Y **N**

- Repair or replace the keylock assembly.

- Replace planar 1; set the jumpers correctly on the new planar (103, 105).

Suggested action for an intermittent problem:

- Analyze the suspected line; inspect all the connector contacts.

- Replacement sequence:
  - Keylock assembly
  - Planar 1

Magnetic Stripe Reader

115 MAGNETIC STRIPE READER VOLTAGE AND CONTROL MINI-MAP

- Use this mini-MAP to correct an MSR problem when the reader fails to read and the characters displayed from the keyboard are correct.
- For mini-MAP example, see "Troubleshooting Aids" (212).

Conditions After Power On

- The voltage lines are active.
- The '-POR' line will be at an Up level.
- The '1.0 MHz osc' line will be pulsing after power on.
- The '+photocell' line will pulse when a card is read by the MSR.
- The 'reg 25 bit 1' line will change level when a card is read by the MSR.

Service Aids

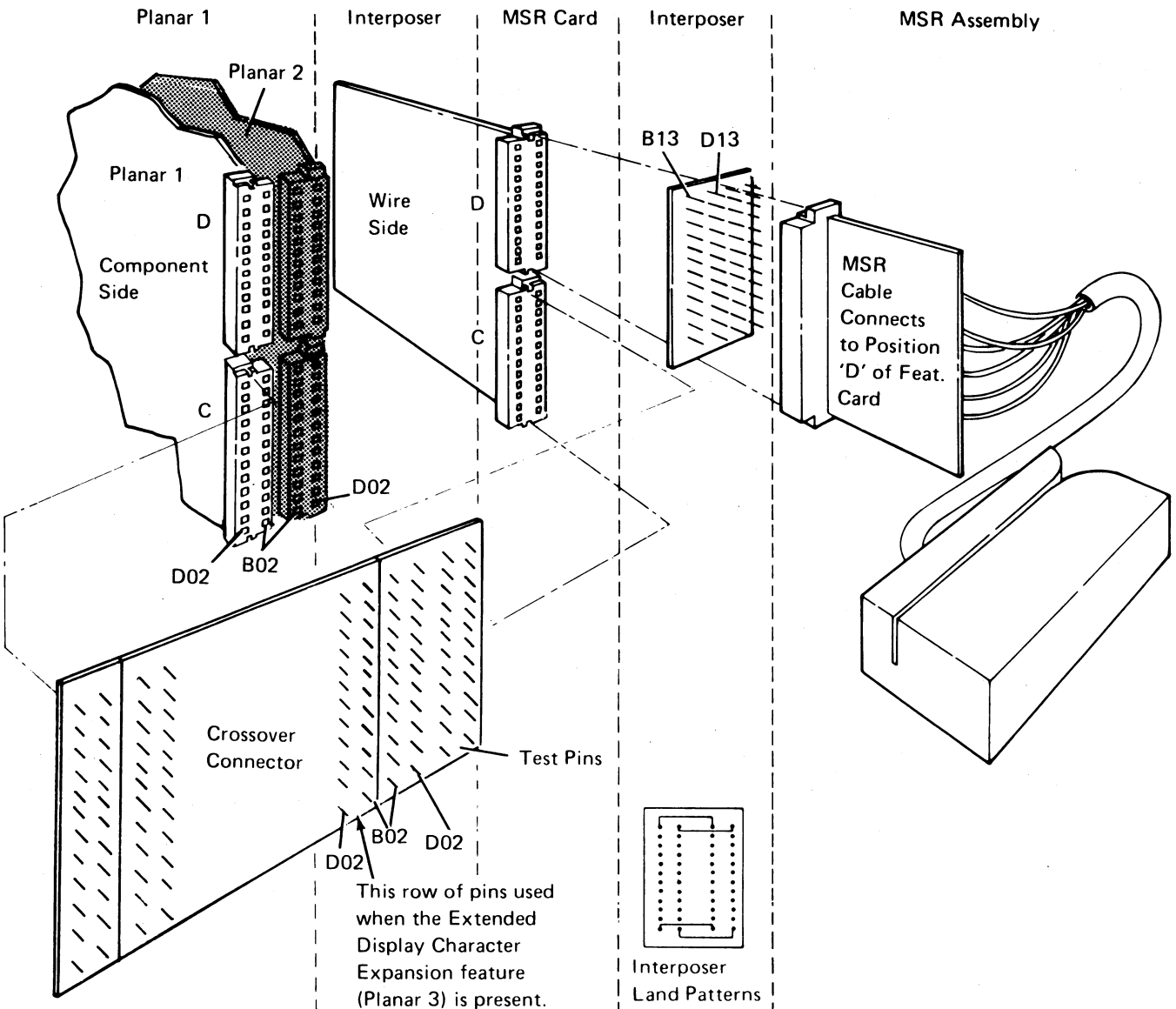
- The '-POR' line will change level during the power-on sequence.
- The display station will *not* be damaged if it is powered on after the MSR cable has been disconnected.
- The MSR test card part number is 8331402.
- The characters that will be displayed in the upper left portion of the display screen when the test card is read by the reader when the display station is in the free key mode are:

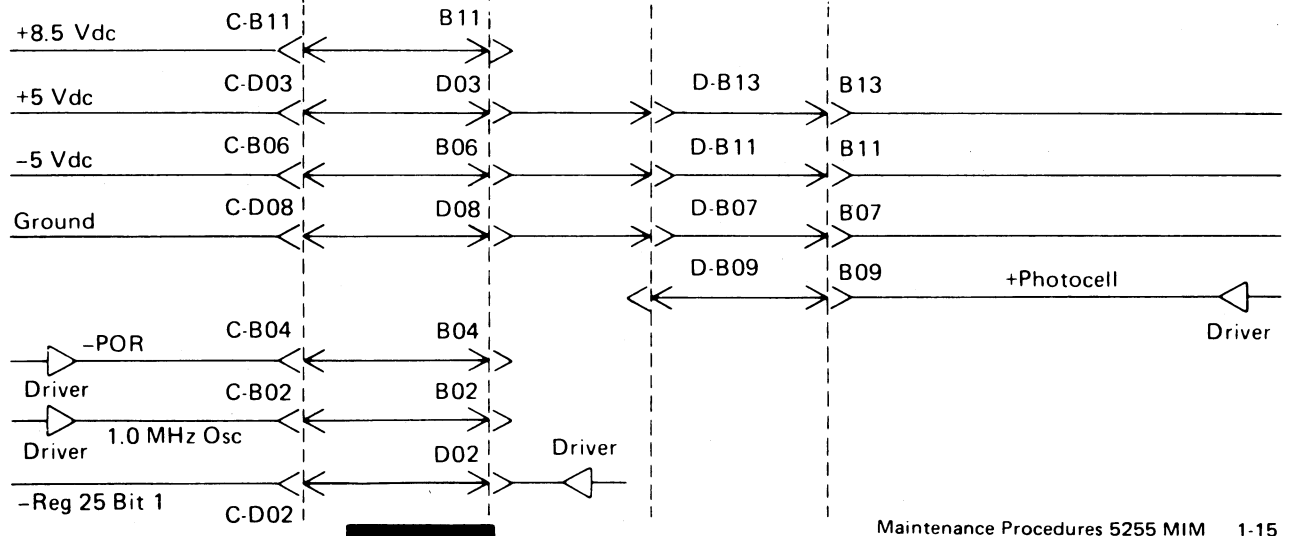
  % % % 0123456789%:@¬=0123456789

Tools

Connect the CE probe as follows:

- + lead–1–G–D03
- – lead–1–G–D08
- Ground–1–B–D08


Planar 1
Interposer
MSR Card
Interposer
MSR Assembly
Planar 2
Planar 1
D
Component Side
C
Wire Side
D
C
B13
D13
MSR Cable Connects to Position 'D' of Feat. Card
D02
D02
B02
Crossover Connector
Test Pins
D02
B02
D02
This row of pins used when the Extended Display Character Expansion feature (Planar 3) is present.
Interposer Land Patterns


+8.5 Vdc
C-B11
B11
+5 Vdc
C-D03
D03
D-B13
B13
-5 Vdc
C-B06
B06
D-B11
B11
Ground
C-D08
D08
D-B07
B07
D-B09
B09
+Photocell
Driver
-POR
Driver
C-B04
B04
C-B02
B02
Driver
1.0 MHz Osc
D02
Driver
-Reg 25 Bit 1
C-D02

115 (continued)

– Check the '+8.5 Vdc' line at connector C of the MSR card.

Is the voltage correct?
Y N

– Inspect the interposer.
– Replace planar 1; set the jumpers correctly on the new planar (103, 105).

– Check the '+5 Vdc' and the '–5 Vdc' lines at connector C of the MSR card.

Are the voltages correct?
Y N

– Inspect the interposer.
– Replace planar 1; set the jumpers correctly on the new planar (103, 105).

– Check the '+5 Vdc' and the '–5 Vdc' lines on the interposer test pins at connector D of the MSR card.

Are the voltages correct?
Y N

– Inspect the interposer.
– Replace the MSR card (119).

– Probe the '+photocell' signal on the interposer test pins at connector D of the MSR card.
– Pass the test card through the reader.

Does the line pulse?
Y N

– Probe the 'ground' line at connector C of the MSR card.

Is the line at a Down level?
Y N

– Inspect the interposer.
– Replace planar 1; set the jumpers correctly on the new planar (103, 105).

– Probe the 'ground' line on the interposer test pins at connector D of the MSR card.

A B

Is the line at a Down level?
Y N

– Inspect the interposer.
– Replace the MSR card (119)

– Power off.
– Disconnect the MSR cable.
– Power on.
– Probe the '+photocell' signal on the interposer at connector D of the MSR card.

Is the line at an Up level?
Y N

– Inspect the interposer.
– Replace the MSR card (119).

– Replace the MSR assembly (119).

– Power off.
– Disconnect the MSR cable.
– Power on.
– Probe the '+photocell' signal on the interposer at connector D of the MSR card.

Is the line at an Up level?
Y N

– Inspect the interposer.
– Replace the MSR card (119).
– Reconnect the MSR cable.

– Power off.
– Reconnect the MSR cable.
– Probe the '-POR' signal at connector C of the MSR card.
– Power on.

Note: The level should change from Down to Up.

Does the line change level?
Y N

– Power off.
– Remove the MSR card (119).
– Probe the '-POR' signal at the planar.
– Power on.

C D

115 (continued)

C D

Does the line change level?
Y N

- Inspect the interposer.
- Replace planar 1; set the jumpers correctly on the new planar (103, 105).

- Replace the MSR card (119).

- Probe the '1.0 MHz osc' signal at connector C of the MSR card.

Is the line pulsing?
Y N

Is the line at an Up level?
Y N

- Replace the MSR card (119).
- Inspect the interposer.
- Replace planar 1; set the jumpers correctly on the new planar (103, 105).

- Inspect the interposer.
- Replace planar 1; set the jumpers correctly on the new planar (103, 105).

- Probe the '-reg 25 bit 1' signal at connector C of the MSR card.

Are both probe lights Off?
Y N

- Check for proper positioning of the jumpers (118).
- Replace the MSR card (119).
- Replace the MSR assembly.

- Inspect the interposer.
- Replace planar 1; set the jumpers correctly on the new planar (103, 105).

Suggested action for an intermittent problem:

- Analyze the suspected line; inspect all the connector contacts.

- Replacement sequence:
  - MSR card
  - MSR assembly
  - Planar 1

116 MAGNETIC STRIPE READER REGISTER 5 MINI-MAP

- Use this mini-MAP to correct an MSR problem when the reader fails to read correctly.
- For mini-MAP example, see "Troubleshooting Aids" (212).

Conditions After Power On

- The '-raw data' line pulses when a card is read by the MSR.
- The '-reg 5' bit line pulses when a card is read by the MSR.

Service Aids

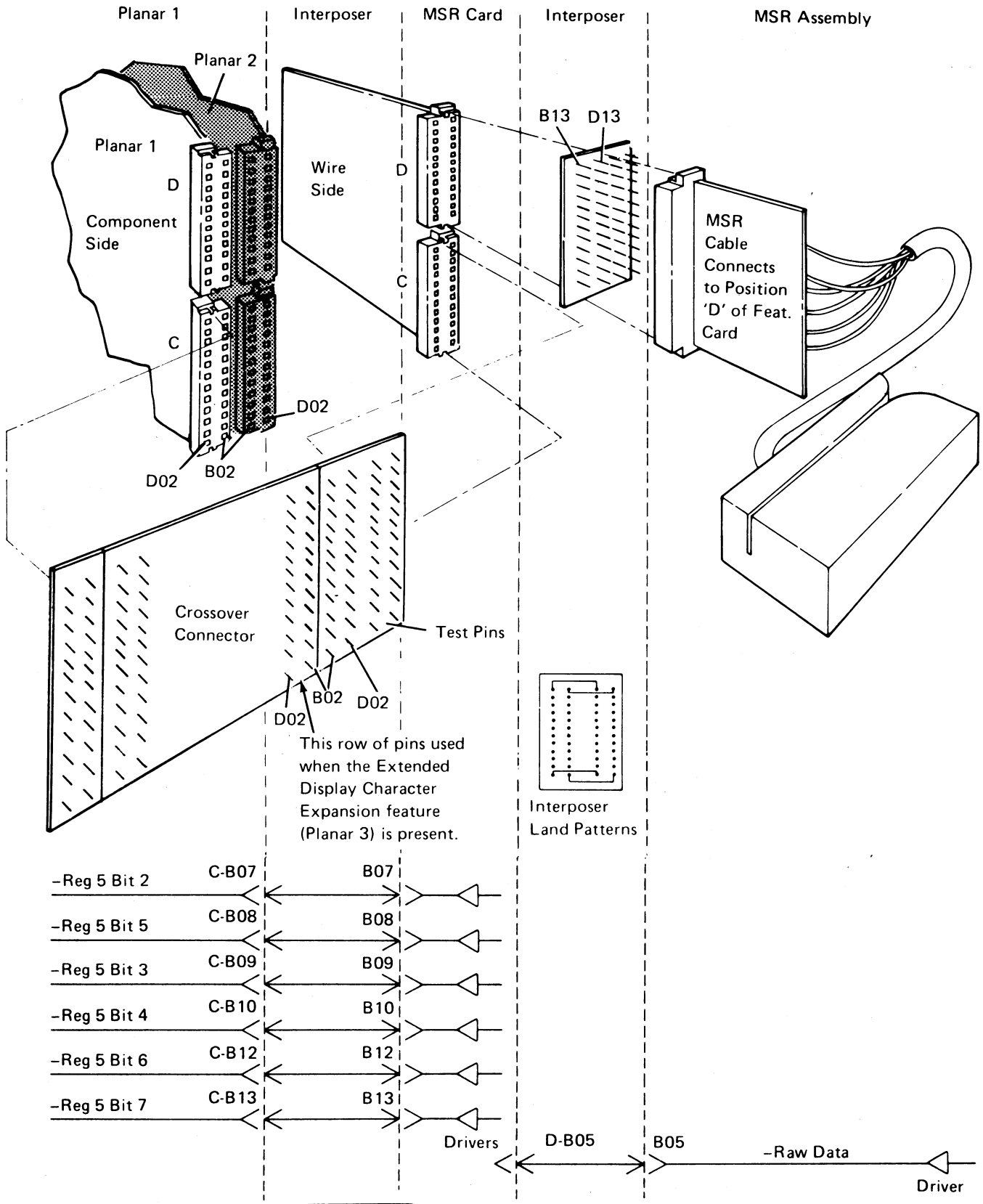
- The display station will *not* be damaged if it is powered on after the MSR cable has been disconnected.
- The MSR test card part number is 8331402.
- The characters that will be displayed in the upper left portion of the display screen when the test card is read by the reader when the display station is in the free key mode are:

  % % %0123456789%:@¬=0123456789

Tools

Connect the CE probe as follows:

- + lead—1—G—D03
- – lead—1—G—D08
- Ground—1—B-D08


Planar 1
Interposer
MSR Card
Interposer
MSR Assembly
Planar 2
Planar 1
D
Component Side
C
Wire Side
D
C
B13
D13
MSR Cable Connects to Position 'D' of Feat. Card
D02
D02
B02
Crossover Connector
Test Pins
D02
B02
D02
This row of pins used when the Extended Display Character Expansion feature (Planar 3) is present.
Interposer Land Patterns
-Reg 5 Bit 2
C-B07
B07
-Reg 5 Bit 5
C-B08
B08
-Reg 5 Bit 3
C-B09
B09
-Reg 5 Bit 4
C-B10
B10
-Reg 5 Bit 6
C-B12
B12
-Reg 5 Bit 7
C-B13
B13
Drivers
D-B05
B05
-Raw Data
Driver

116 (continued)

- Probe the '-raw data' signal on the interposer test pins at connector D of the MSR card.
- Pass the test card through the reader.

Does the line pulse?
Y N

- Power off.
- Disconnect the MSR cable.
- Power on.
- Probe the '-raw data' signal on the interposer at connector D on the MSR card.

Is the line at an Up level?
Y N

- Replace the MSR card (119).
- Reconnect the MSR cable.

- Replace the MSR assembly (119).

- Power off.
- Disconnect the MSR cable.
- Power on.
- Probe the '-raw data' signal on the interposer at connector D of the MSR card.

Is the line at an Up level?
Y N

- Replace the MSR card (119).
- Reconnect the MSR cable.

- Power off.
- Reconnect the MSR cable.
- Power on.
- Probe the register 5 bit lines at connector C of the MSR card.

Are both probe lights off for any line?
Y N

- Replace the MSR card (119).

- Inspect the interposer.
- Replace planar 1; set the jumpers correctly on the new planar (103, 105).

Suggested action for an intermittent problem:

- Analyze the suspected line; inspect all the connector contacts.

- Replacement sequence:
  - MSR card
  - MSR assembly
  - Planar 1

117 MAGNETIC STRIPE READER REGISTERS 5 AND 13 MINI-MAP

- Use this mini-MAP to correct an MSR problem when the reader fails to read correctly.
- For mini-MAP example, see "Troubleshooting Aids" (212).

Conditions After Power On

- The '-station 1/2 jumper' line is at an Up level.
- The five register lines pulse when a card is read by the MSR.

Service Aids

- The display station will *not* be damaged if it is powered on after the MSR cable has been disconnected.
- The MSR test card part number is 8331402.
- The characters that will be displayed in the upper left portion of the display screen when the MSR test card is read by the reader when the display station is in the free key mode are:

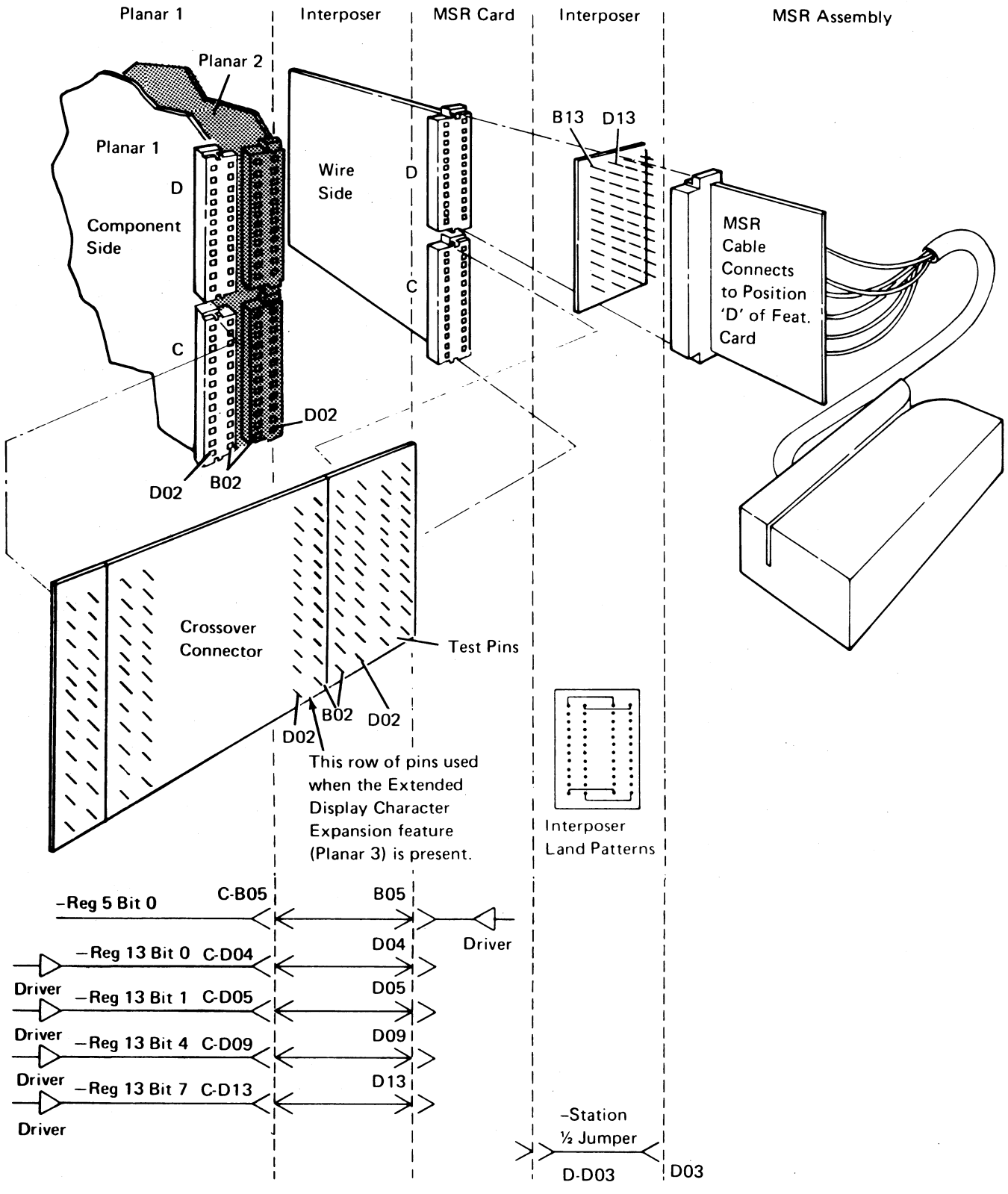
  % % %0123456789%:@¬=0123456789

Tools

Connect the CE probe as follows:

- + lead–1–G–D03
- –lead–1–G–D08
- Ground–1–B–D08

117 (continued)



117 (continued)

- Power off.
- Disconnect the MSR cable.
- Power on.
- Probe the '-station 1/2 jumper' signal on the interposer at connector D of the MSR card.

Is the line at an Up level?

Y

- Check for proper positioning of the jumpers (118).
- Inspect the interposer.
- Replace the MSR card (119).
- Reconnect the MSR cable.

N

- Power off.
- Reconnect the MSR cable.
- Power on.
- Probe the five register signals at connector D of the MSR card.

Are both probe lights off for any line?

Y

- Replace the MSR card (119).

N

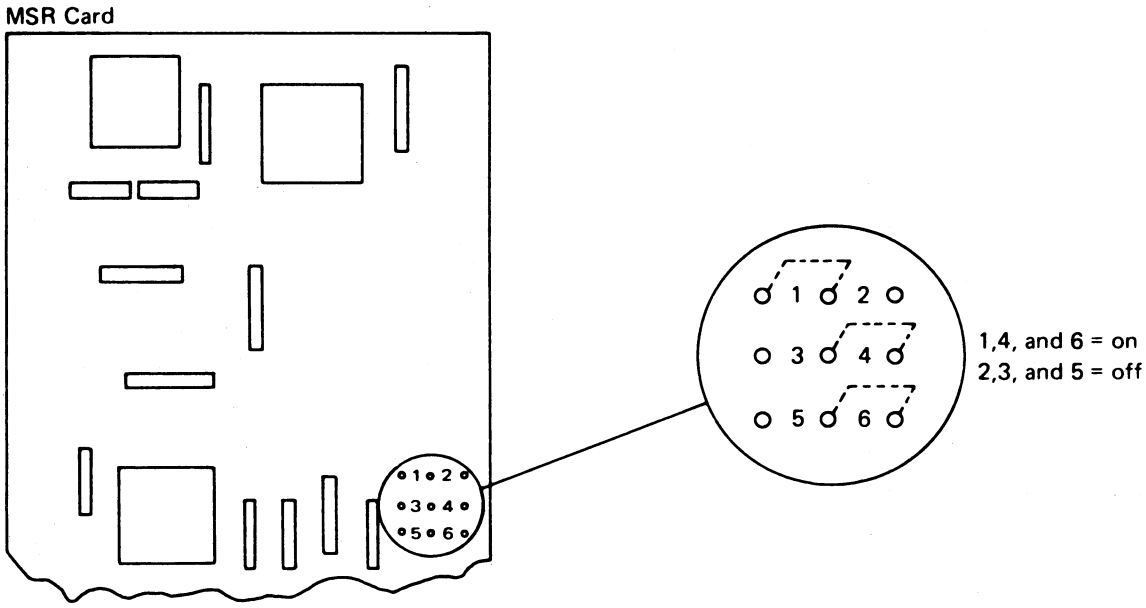
- Inspect the interposer.
- Replace planar 1; set the jumpers correctly on the new planar (103, 105).

Suggested action for an intermittent problem:

- Analyze the suspected line; inspect all the connector contacts.

- Replacement sequence:
  - MSR card
  - MSR assembly
  - Planar 1

118 MAGNETIC STRIPE READER CARD JUMPERING



119 MAGNETIC STRIPE READER INSTALLATION AND REMOVAL

Installation

1. Turn the Power switch off.
2. Open the rear cover.
3. Hold the MSR feature card so that the component side is facing you.
4. Place the small interposer on the left hand side connector of the card; the test pins on the interposer must face the component side of the card.
5. Place the MSR feature card in positions C and D on the stiffener; ensure that the component side of the card is facing out (103).
6. Secure the card to the stiffener, using plastic clips.
7. Lower the planar to allow access to the bottom row of connectors.
8. While holding the MSR feature card, insert the large interposer in position C so that the pins on the interposer enter the slots on both the card and planar 1.
9. Place the planars in the service position.
10. Loosen the screw on the plate that covers the line cord. This plate is located on the right rear corner.
11. Remove the plate.

    CAUTION
    Ensure that the remaining three corners remain firmly on the table.

12. Rotate the 5255 until the right rear corner is positioned off the table.
13. Feed the MSR cable through the same slot that the line cord passes through. Feed in enough cable so that the ground strap on the cable is inside the machine.
14. Connect the ground strap to a ground screw on the machine.
15. Connect the cable to position D on the MSR card.
16. Place the plate that was removed in step 11 over the MSR cable and the line cord and tighten the screw.
17. Move the 5255 back onto the table.•
18. Place the planars in the operating position.
19. Close the rear cover.

Removal

To remove the MSR feature, reverse the preceding steps.

120 EXTENDED DISPLAY CHARACTER RAM MINI-MAP

- Use this mini-MAP to isolate a failure in the Extended Display Character Ram.
- For mini-MAP example, see "Troubleshooting Aids" (212).

Conditions After Power On

Service Aids

- Check that jumper is in position 2A on planar 1 (105).

Is the jumper set correctly?

Y N

- Correct the jumper.
- Verify the fix.

- Power off.
- Inspect and reseat all crossover connectors to ensure good electrical connections.

Are the connections OK?

Y N

- Correct the crossover failure.
- Verify the fix.

- Power on.
- Check the voltages to planar 2 (182).

Are the voltages correct?

Y N

- Use MIM 188 to isolate power problem.

- Replace planar 2 (103).
- Replace planar 1; set jumpers correctly on new planar (103, 105).
- Verify the fix.

121 EXTENDED DISPLAY CHARACTER FEATURE CARD MINI-MAP

- Use this mini-MAP to isolate failures in the Extended Display Character Feature card.
- For mini-MAP example see "Troubleshooting Aids" (212).

Conditions After Power On

Service Aids

- Check that jumper is in position 2B on planar 1 (105).

Is the jumper set correctly?
Y N

- Power off.
- Set the jumper correctly.
- Verify the fix.
- Power on

Do the power-on diagnostics execute correctly?
Y N

- Power off
- Remove planar 3 electrically by disconnecting the planar from its crossover connections to the other planars. Temporarily move jumper on planar 1 from position 2B to 2A (105).
- Power on.

Do the power-on diagnostics execute correctly now?
Y N

- Power off.
- Replace planar 2 (103).
- Replace planar 1; set jumpers correctly on new planar (103, 105).
- Verify the fix.

- Power off.
- Inspect and reseat all crossover connectors.

Are the crossovers OK?
Y N

- Correct the crossover failure.
- Verify the fix.

- Check the voltages to planar 3. (See chart in this section.)

A B

A B

Are the voltages correct?
Y N

- Repair/replace power cable. (See the diagram in this section.)

- Replace Planar 3 (103).
- Verify the fix.

- Verify the customer character pattern assignments and RAM locations.

Character pattern assignments OK?
Y N

- Customer responsibility. Correct the character pattern assignments or RAM locations.

- Power off.
- Inspect and reseat all crossover connectors to ensure good electrical connections.

Are the connections OK?
Y N

- Correct the crossover failure.
- Verify the fix.

- Power on.
- Check the voltages to planar 3. (See the chart in this section.)

Are the voltages correct?
Y N

- Repair/replace power cable. (See the diagram in this section.)

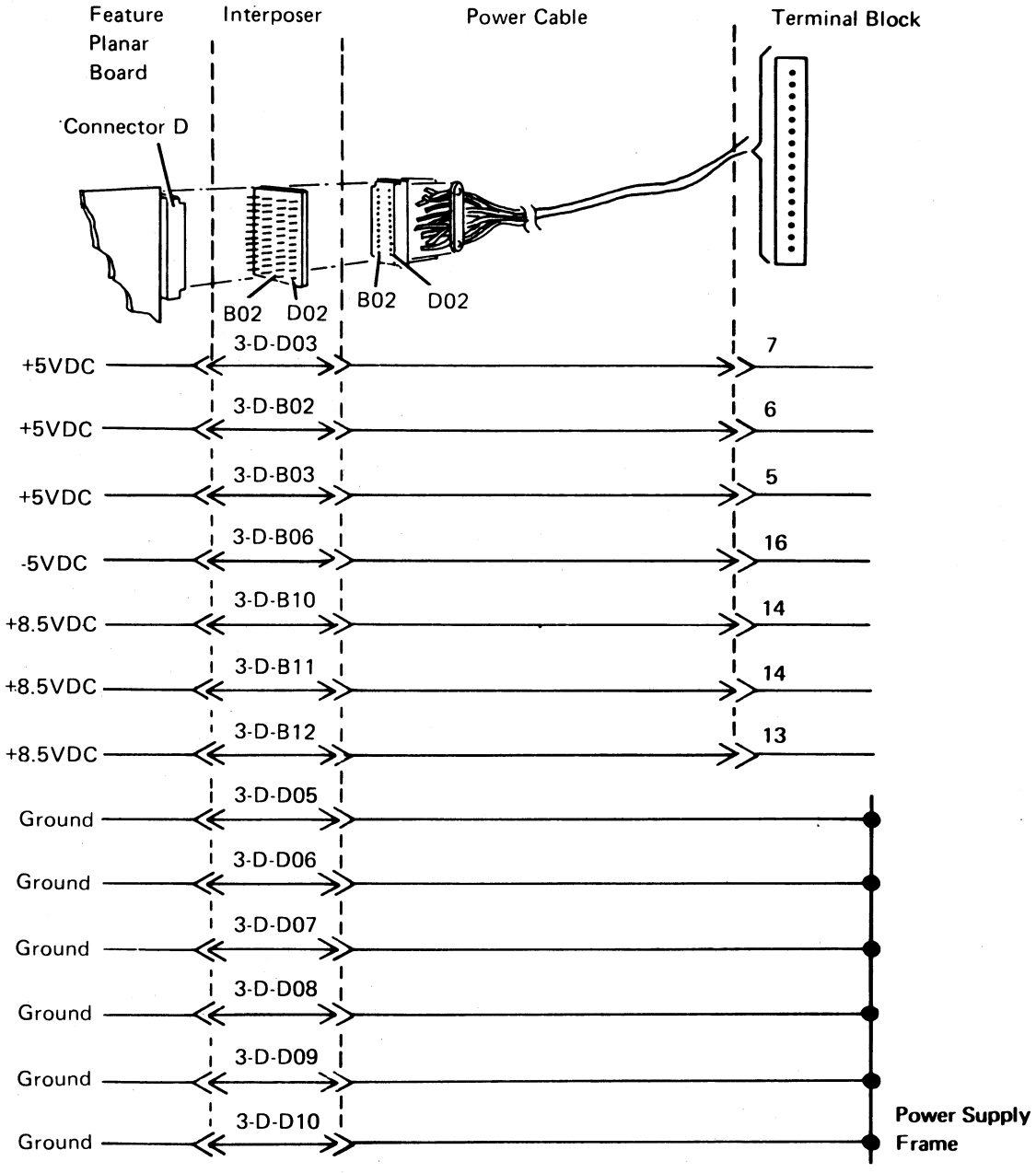
- Replace planar 3 (103).
- Replace planar 2 (103).
- Replace planar 1; set jumpers correctly on new planar (103, 105).

121 (continued)

Planar 3 Voltage Checks

DC Voltage Levels	Planar Board 3, Connector D (103)
+5 (+4.7 to +5.5)	D03, B02, B03
−5 (−4.6 to −5.4)	B06
+8.5 (+7.7 to +9.4)	B10, B11, B12
Ground	D05 through D10

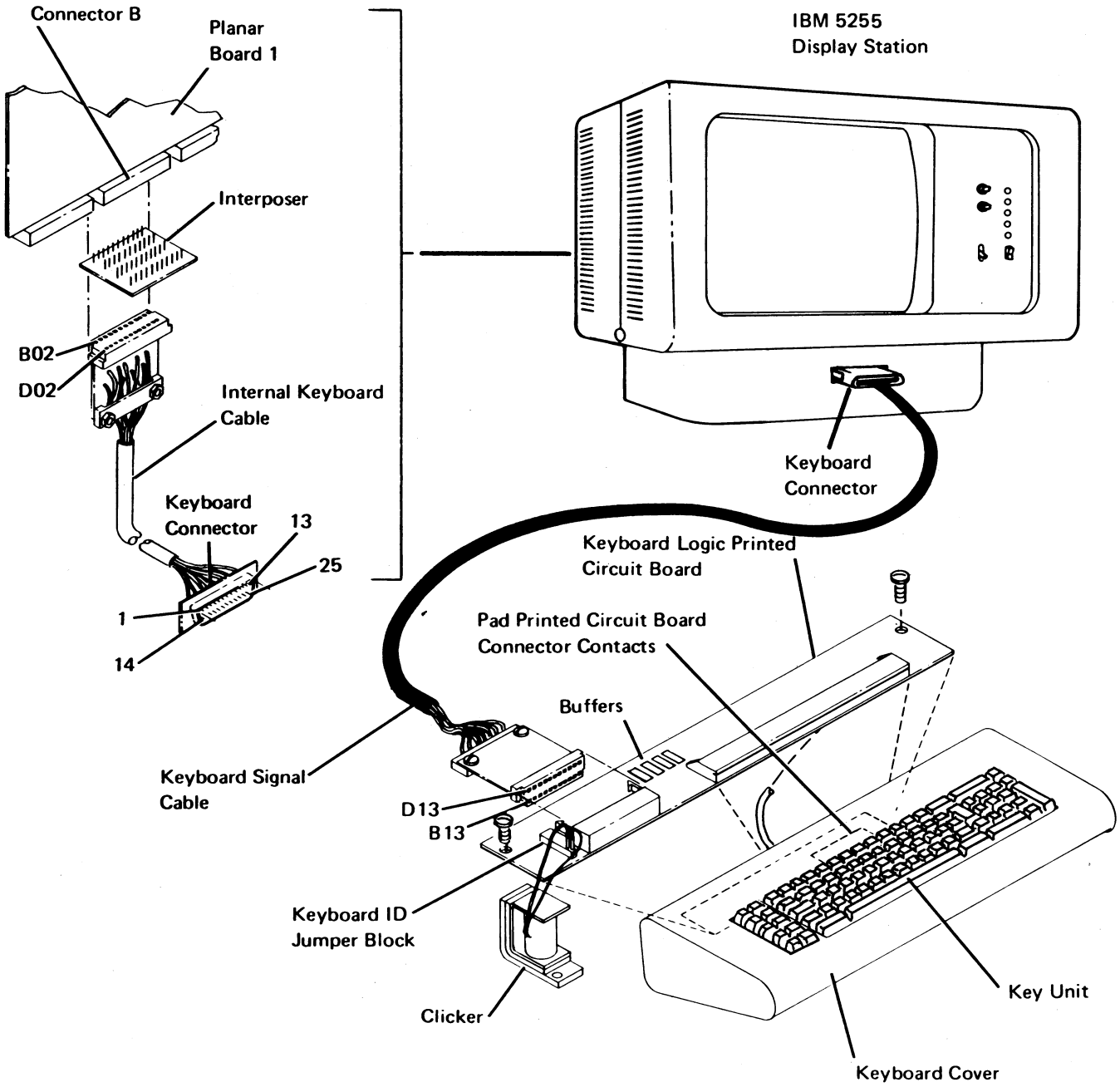
Planar 3 Power Cable



KEYBOARD

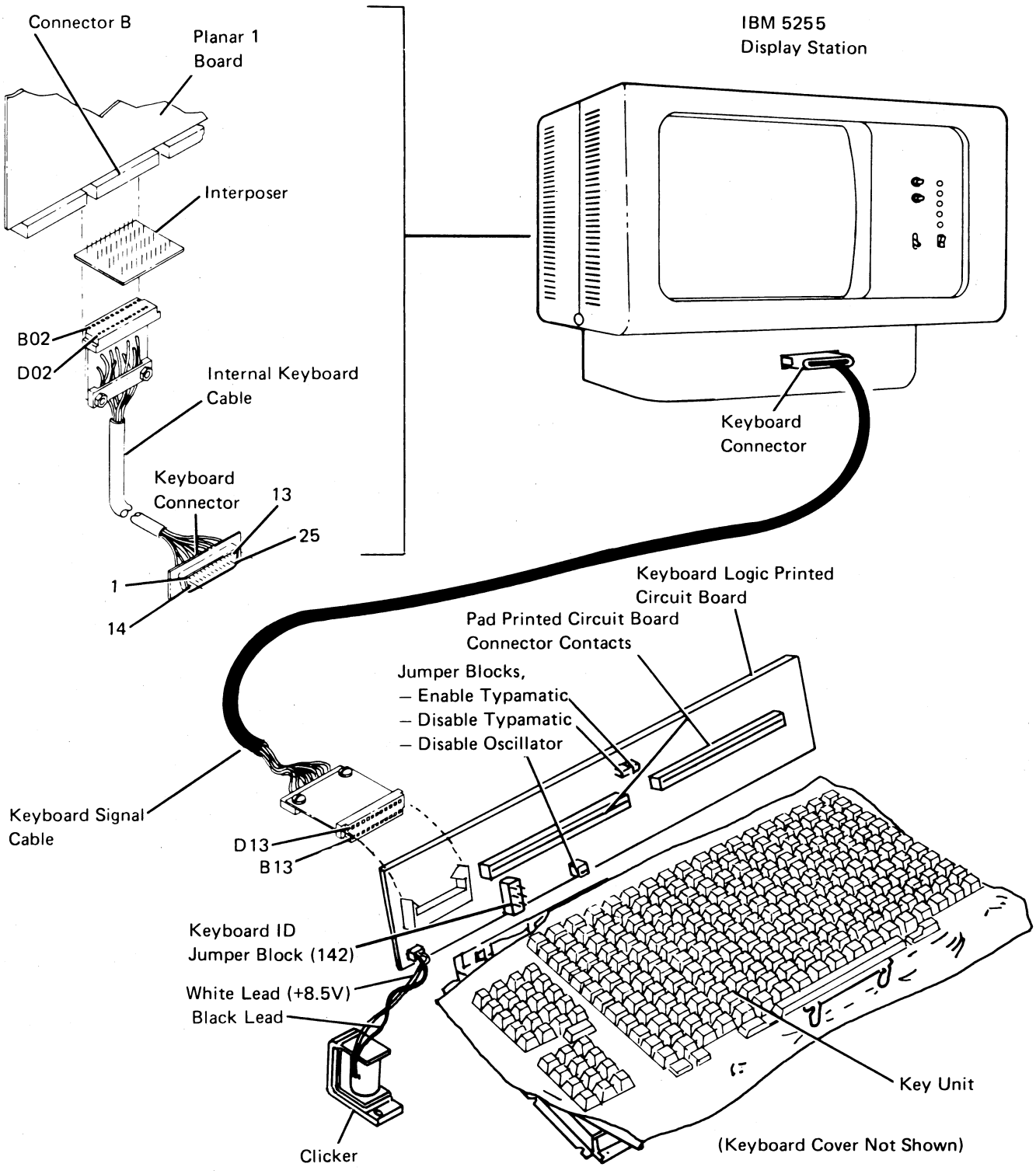
130 KEYBOARD LOCATIONS

Alphanumeric Keyboard

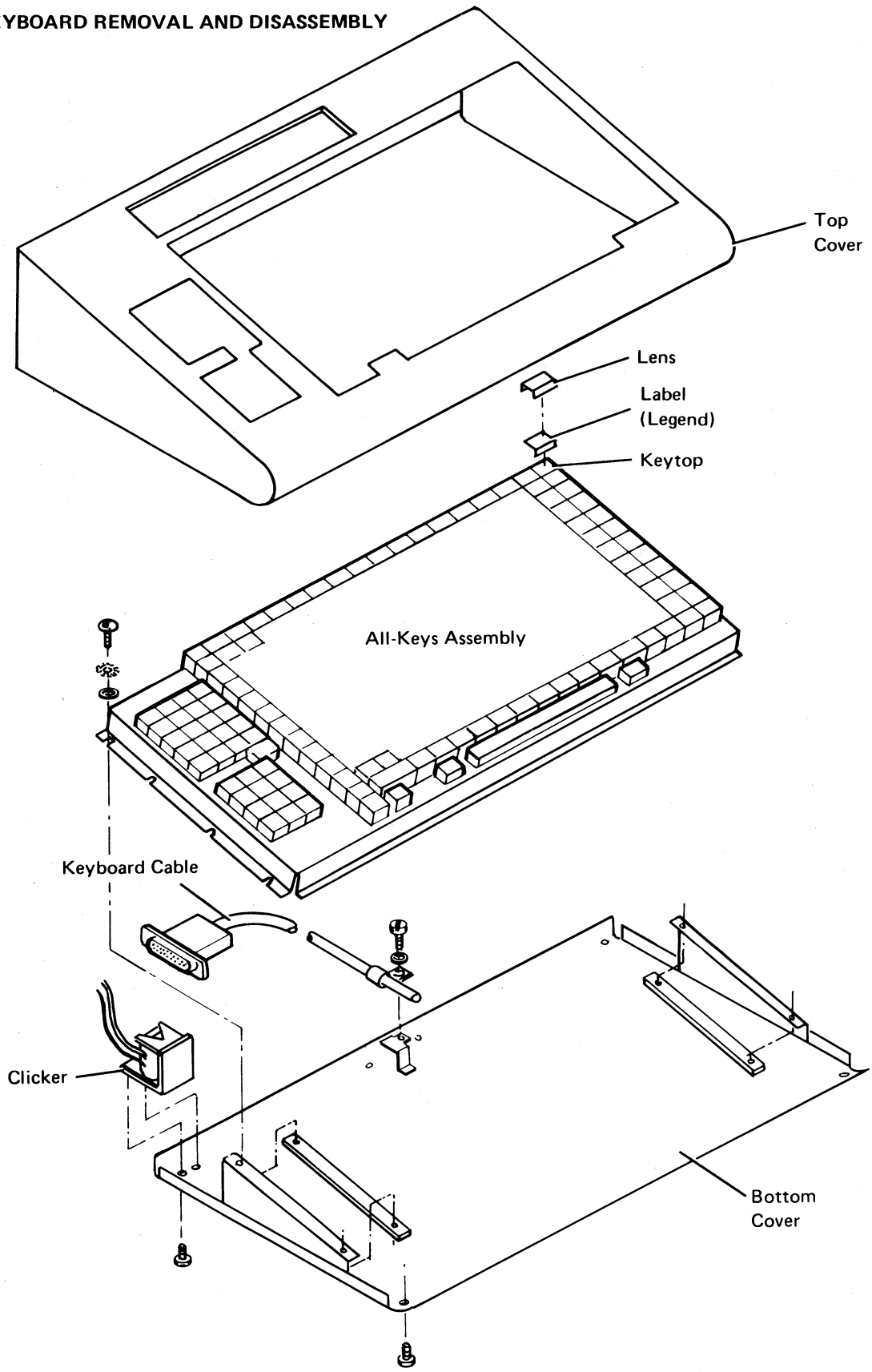


130 KEYBOARD LOCATIONS (continued)

Ideographic Keyboard



131 KEYBOARD REMOVAL AND DISASSEMBLY



131 (continued)

Alphanumeric Keyboard

Removal

1. Power off.
2. Loosen the four screws on the bottom of the keyboard assembly.
3. Remove the keyboard cover.

Disassembly

1. Remove four screws on each side of the keyboard (130).
2. Remove the keyboard logic printed circuit board (130).
3. If a key module is to be removed, locate the position of the key before the keyboard is inverted and pull off the keytop; use the keytop removal tool (part 9900373).
4. Lift the key unit out of the keyboard base.

CAUTION
The keyboard assembly must be kept free of dirt.

5. Invert the key unit and reinstall it on the original mounting block; use a screw on each side to hold the assembly in place.

CAUTION
Do not remove the pad printed circuit board while a key is pressed. Removing the pad printed circuit board while a key is pressed causes the flyplate to jump out of the key module.

6. Ensure that there is no pressure on any keys.
7. Remove the screws from the pad printed circuit board.
8. Slowly lift the pad printed circuit board from the key assembly.

Assembly

To assemble, reverse the above procedure.

Ideographic Keyboard

Removal

1. Ensure that the machine is powered off.
2. Remove the keyboard cover (109).
3. Remove the four keyboard assembly mounting screws (on each side of the keyboard).
4. Unplug the keyboard cable from the keyboard logic board.
5. If a key module is to be removed (133), locate the position of the key before the keyboard is inverted and pull off the keytop; use the keytop removal tool (part 9900373).
6. Lift the keyboard assembly out of the keyboard base by its flange edges using care not to damage the cable retainer.

CAUTION
The keyboard assembly must be kept free of dirt.

Replacement

1. Locate the keyboard assembly on the keyboard base.
2. Replace the mounting screws.
3. Connect the keyboard cable to the keyboard logic board.
4. Replace the keyboard cover (109).

131A IDEOGRAPHIC KEYBOARD PRINTED CIRCUITRY

Removal

1. Ensure that the machine is powered off.
2. Remove the keyboard cover (109).
3. Remove the keyboard assembly (131).
4. Remove the three screws that hold the logic board to the tabs of the baseplate.
5. Work the logic board connectors off the connector tabs of the printed-circuit-pad board.
6. Remove the keyboard clicker assembly from its mounting on the bottom cover.
7. Invert the keyboard assembly and reinstall it on the original mounting brackets as shown in the illustration in this section. Use a screw on each side to hold the assembly in place.

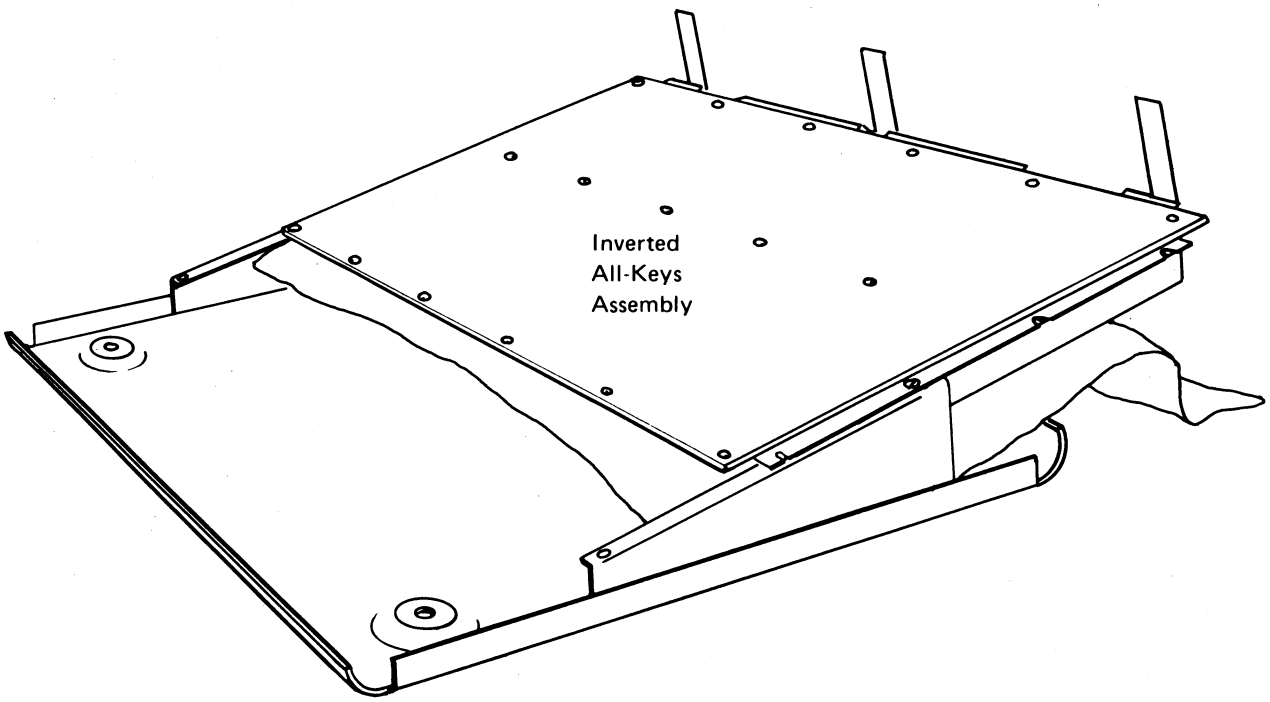
   Note: The second keyboard-assembly slot (from the bottom) aligns with the top hole of the mounting bracket. In this position, the keytops should not touch any part of the keyboard covers.

CAUTION
To prevent loss of flyplates, ensure that no keys are pressed while the keyboard baseplate is removed. If a flyplate comes off, replace the key module (133).

8. Remove the 17 screws holding the baseplate of the keyboard to the all-keys assembly.
9. Lift the baseplate and printed-circuit-pad off the all-keys assembly as a unit.

Replacement

To replace, reverse the above procedure.



132 CLEANING

CAUTION

If you use excessive pressure when cleaning the flyplates, you could cause them to become disengaged from the spring. If a flyplate comes off, replace the key module (133).

1. Disassemble the keyboard (131 or 131A).

2. Clean the pad printed circuit board with a lint-free cloth that is moistened with water. Check the flyplates for dirt; clean only those flyplates that are dirty or are causing failures.

133 KEY MODULE

Removal

1. Use the keytop removal tool (part 9900373) to lift the keytops from the keys to be removed.

CAUTION
To prevent loss of a flyplate, ensure that no keys are pressed while the keyboard baseplate is removed. If a flyplate comes off, replace the key module.

---

2. Disassemble the keyboard (131). The keyboard should be in the inverted position (131A).

3. Reach under the key unit and push up the failing key module until it is free.

Note: The module retaining ears must clear the keyboard frame.

Installation (Ideographic Keyboard)

1. Observe the orientation of the installed key modules. Ensure that the alignment lug and key stem are in the same position as on the installed key modules.

2. Snap the key module into the keyboard frame by hand (from the top of the inverted all-keys assembly; see the diagram in section 131A).

3. Replace the printed circuit boards and baseplate (131A).

4. Replace the keytop.

Installation (Alphanumeric Keyboard)

1. Insert the key module. Align the opening in the key module with the location lug in the mounting hole. The key stem must be positioned, so the notch is facing the Spacebar edge of the keyboard.

2. Reinstall the pad printed circuit board.

3. Turn the key unit over and, if necessary, place the dust shield in the correct position.

4. Put the keytop on the key unit.

5. Reinstall the logic printed circuit board and cover.

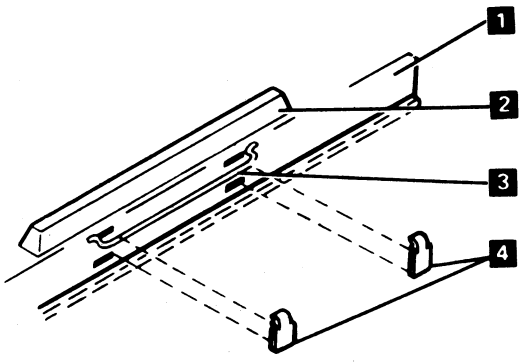
134 SPACEBAR

Removal

1. Disassemble the keyboard (131).
2. Hold the ends of the Spacebar and pull up to slide the bar off the key stems.
3. If the pivots need to be removed, insert a screwdriver tip in the opening in the side of the frame; then, twist the screwdriver slightly until the pivot is removed.

Installation

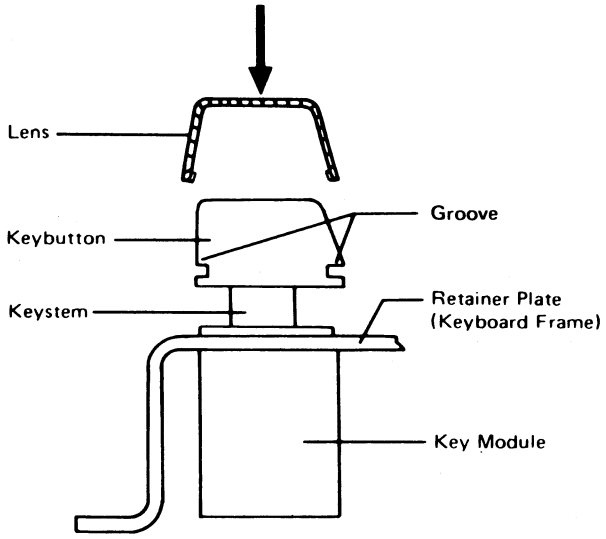
1. Press the pivots 4 into place in the frame 1.
2. Place the Spacebar 2 into position over its key modules.
3. Guide the stabilizer 3 into the openings in the pivots.
4. Press the Spacebar on the key stems.



135 KEY LENS REMOVAL-REPLACEMENT

Key lenses break easily; use the following procedure to change the key legend or when the lens is damaged only.

1. Insert a sharp (preferably hooked) object under the edge of the lens and pry the lens out of the groove on the key button.
2. Repeat this action with the other edge of the lens; lift off the lens.
3. The key legend is now exposed and can be exchanged.
4. To replace the keytop lens, place it directly on the keybutton and press down until both edges snap into the grooves.



136 KEYBOARD ID MINI-MAP

- Use this mini-MAP to locate an open or grounded ID line.
- For mini-MAP example, see "Troubleshooting Aids" (212).

Conditions After Power On

- ID lines *with* jumpers are at a Down level and a 1 is displayed in the ID field while the Status switch is in the Test position.
- ID lines *without* jumpers are at an Up level and a 0 is displayed in the ID field while the Status switch is in the Test position.

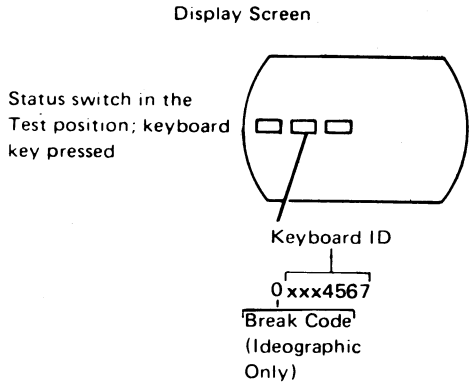
Service Aids

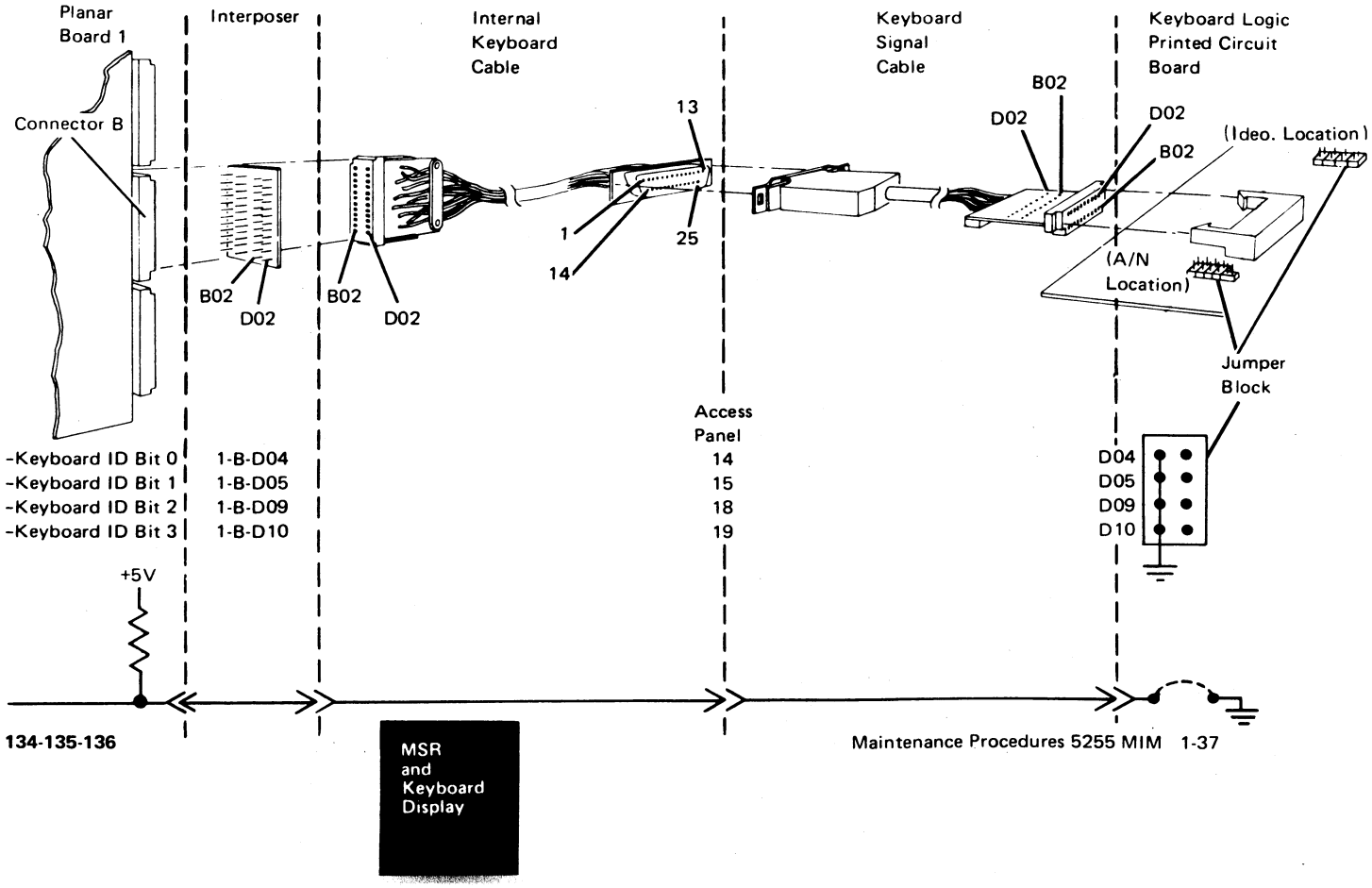
- Verify that the ID jumpers shown on the "Keyboard Identification" chart (142) are correct.
- The display station will *not* be damaged if it is powered on after the keyboard cable has been disconnected.

Tools

Connect the CE probe as follows:

- +lead–1–G–D03
- –lead–1–G–D08
- Ground–1–B–D08





136 (continued)

- Check each signal line at the planar with the ID jumper installed on the jumper block. (For locations, see the diagram in this section: 136.)

Is each line at a Down level?

Y N

- Check for an open line back through the keyboard logic PC board.

- Check the line at the planar with the ID jumper removed.

The line should be at an Up level.

Is the line at an Up level?

Y N

- Leave the jumper off.
- Check the line from the planar back to the jumper block on the logic PC board for a ground.

Is the line OK?

Y N

- Set the ID jumpers correctly.
- Replace the cable or keyboard logic PC board.

- Inspect the interposer.
- Replace planar 1; set the jumpers correctly on the planar (103, 105).
- Set the ID jumper correctly.

- Inspect the interposer.
- Replace planar 1; set the jumpers correctly on the planar (103, 105).
- Set the ID jumper correctly.

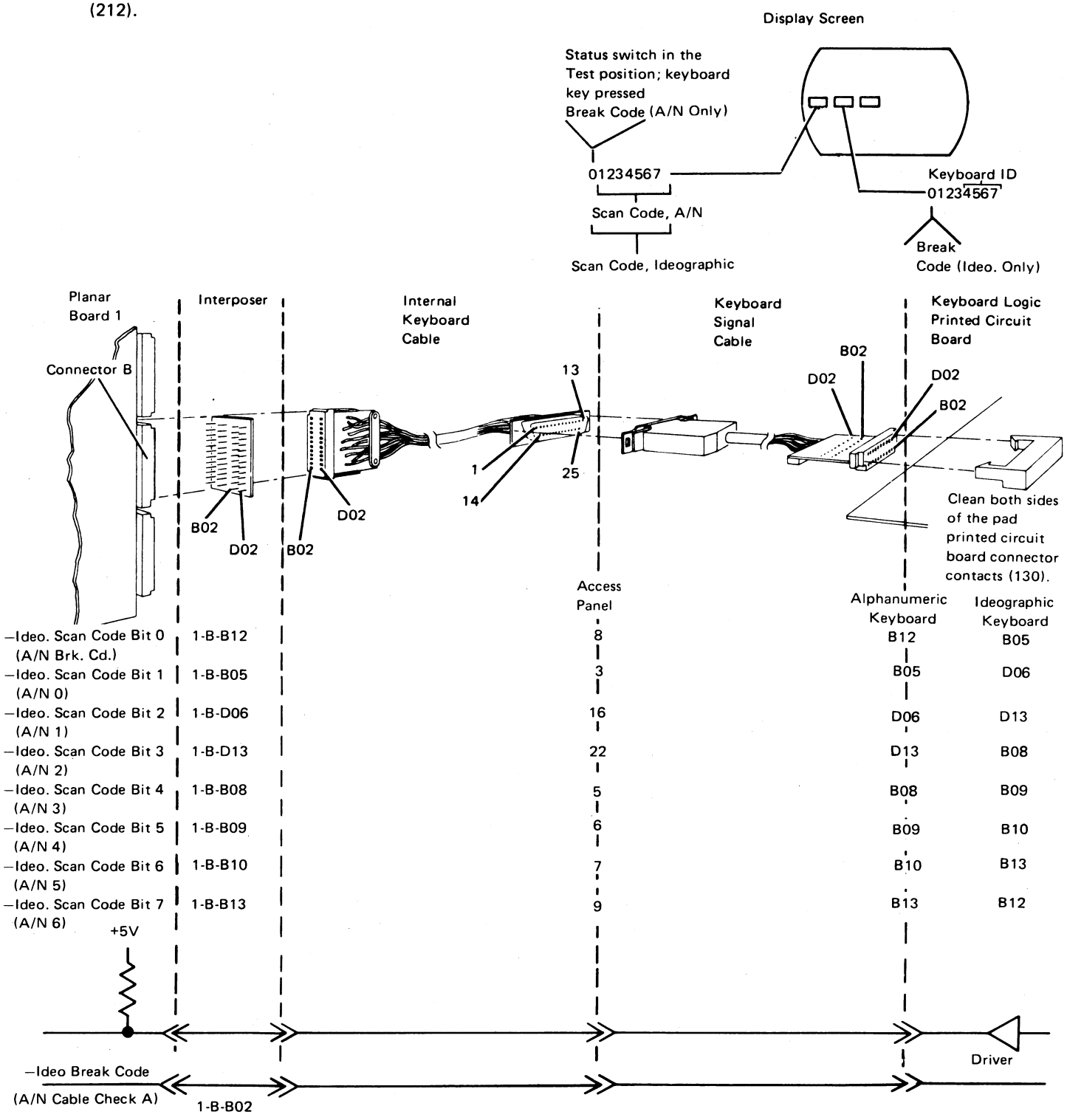
Suggested action for an intermittent problem:

- Analyze the suspected line; inspect all the connector contacts.

- Replacement sequence:
  - Planar 1
  - Keyboard cables
  - Keyboard logic PC board

137 KEYBOARD SCAN CODE MINI-MAP

- Use this mini-MAP to locate an open or grounded scan code line.
- For mini-MAP example, see "Troubleshooting Aids" (212).



Conditions After Power On

The scan code lines are valid after a key has been pressed.

Service Aids

- All scan code lines are switched Up and Down when you press a keyboard key. A 1 is displayed in the scan code field on the display screen when a line is active.

- If an alphanumeric keyboard is attached, use the Shift key to test the '-break code' line. The break code position in the displayed field is normally 0. The position changes to 1 only after a Shift key has been pressed and released. When an ideographic keyboard is attached, the break code is 0 until any key is pressed. It then becomes a 1 each time a key is released (It changes to 0 each time a key is pressed.)

- Scan code signal lines from the ideographic keyboard are free-running; lines pulse even when no signal is active. Your CE probe must be gated with the +Delay Strobe signal.

- The display station will *not* be damaged if it is powered on after the keyboard cable has been disconnected.

Tools

Connect the CE probe as follows:

- +lead–1–G–D03
- –lead–1–G–D08
- Ground–1–B–D08
- +gate lead–1B–D11 (when required)

137 (continued)

- Refer to "Keyboard Arrangement" and "Scan Code Tables" (143, 144).

- Check the failing scan code or break code line at the planar (the bit line that did not change).

- Press and release a key that should activate the line. (Scan code lines from the ideographic keyboard pulse without pressing a key. The break code line is positive and pulses while a key is held down.)

Does the line pulse?

Y N

Is the line at a Down level?

Y N

- Check the line in the cables for an open.

Are the cables OK?

Y N

- Replace the failing cable.

- If the ideographic keyboard is attached, check the POR line (141).
- Replace the keyboard logic PC board; set the jumpers correctly on the new PC board (142).

- Disconnect the cable at the keyboard end.

Is the line still at a Down level?

Y N

- Replace the keyboard logic PC board; set the jumpers correctly on the new PC board (142).

- Disconnect the cable at socket B on the planar.

Is the line still at a Down level?

Y N

- Repair or replace the failing keyboard cable.

- Replace planar 1; set the jumpers correctly on the new planar (103, 105).

Is the ideographic keyboard attached?

Y N

- Inspect the interposer.
- Replace planar 1; set the jumpers correctly on the new planar (103, 105).

- Set the probe Gate Ref to +1.4V and connect +Gating to the +Delay Strobe line at 1–B–D11.
- Press and release a key that should activate the line being probed.

Does the line go positive each time the key is pressed and again each time it is released?

Y N

- Replace the keyboard logic PC board. Set the jumpers correctly on the new PC board (130, 142).

- Inspect the interposer.
- Replace planar 1; set the jumpers correctly on the new planar (103, 105).

Suggested action for an intermittent problem:

- Analyze the suspected line; inspect all the connector contacts.

- Clean the pad PC board contacts.

- Replacement sequence:
  - Keyboard logic PC board
  - Planar 1
  - Keyboard cables

138 KEYBOARD VOLTAGE AND STROBE MINI-MAP

- Use this mini-MAP to correct a data strobe, power-on reset, or strobe delay problem.
- For mini-MAP example, see "Troubleshooting Aids" (212).

Conditions After Power On

- The voltage lines are active.
- The '-data strobe' line is positive (+) (the pulse will be negative when you press a key).
- The 'power-on reset' line is at an Up level.
- The '+delay strobe' line is negative (—) (the pulse will be positive when you press a key.)

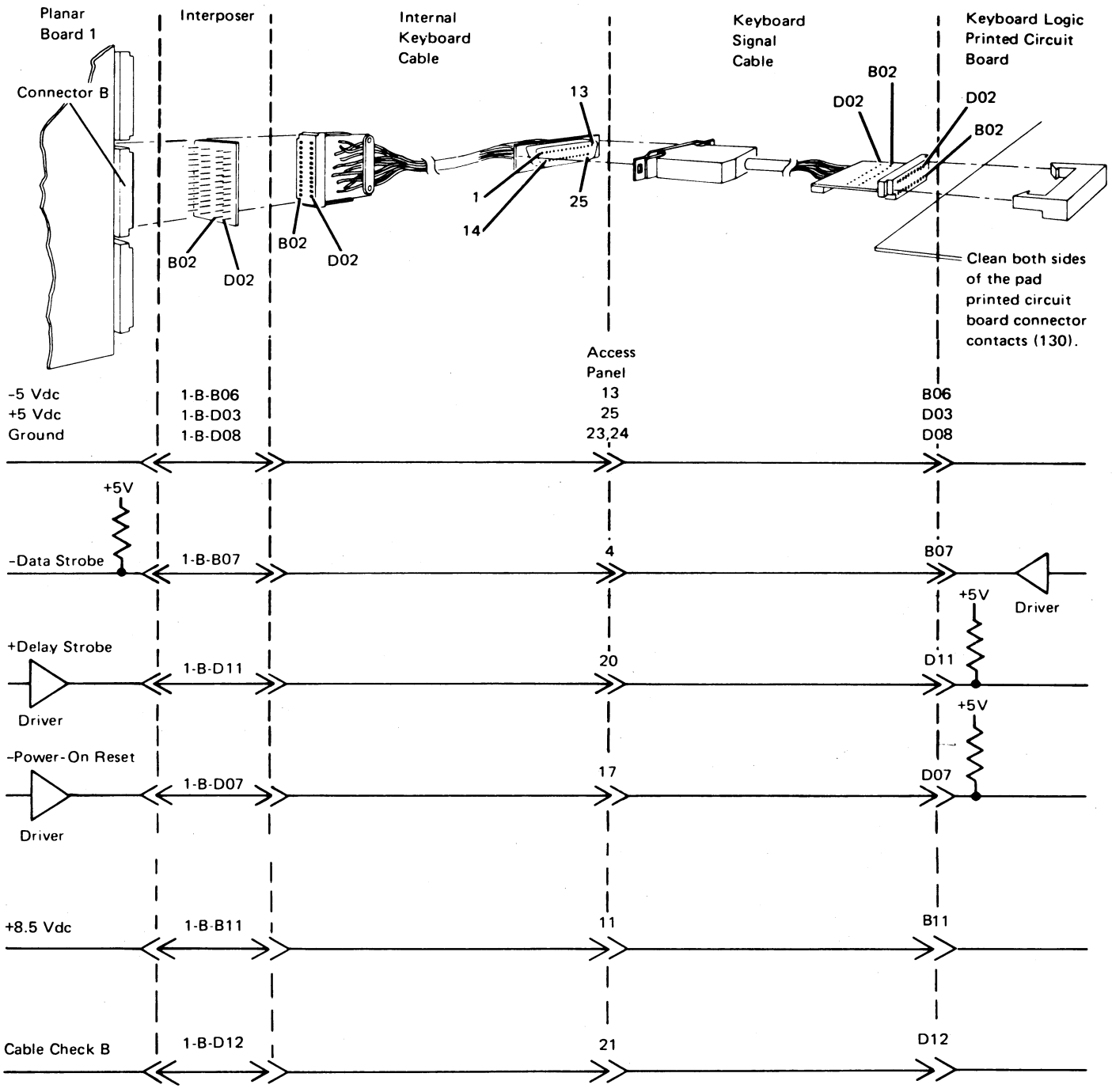
Service Aids

- Ensure that the keyboard cable is plugged correctly before measuring signal lines.
- The 'power-on reset' line is at a Down level for about 0.5 seconds during power on.
- When you press a key, the '—data strobe' line pulses at a Down level.
- When the planar receives the '—data strobe' line, it pulses the '+delay strobe' line at an Up level.
- A failure in the '—5 Vdc', '+5 Vdc', '—data strobe', or '+delay strobe' line causes both the '—data strobe' and '+delay strobe' lines to fail.
- The display station will *not* be damaged if it is powered on after the keyboard cable has been disconnected.

Tools

Connect the CE probe as follows:

- +lead—1—G—D03
- —lead—1—G—D08
- Ground—1—B—D08


Planar Board 1
Interposer
Internal Keyboard Cable
Keyboard Signal Cable
Keyboard Logic Printed Circuit Board
Connector B
B02
D02
B02
D02
13
1
14
25
B02
D02
D02
B02
Clean both sides of the pad printed circuit board connector contacts (130).
Access Panel
-5 Vdc
+5 Vdc
Ground
1-B-B06
1-B-D03
1-B-D08
13
25
23,24
B06
D03
D08
+5V
-Data Strobe
1-B-B07
4
B07
Driver
+5V
+Delay Strobe
1-B-D11
20
D11
Driver
+5V
-Power-On Reset
1-B-D07
17
D07
Driver
+8.5 Vdc
1-B-B11
11
B11
Cable Check B
1-B-D12
21
D12

138 (continued)

– Check the '–power on reset' line at the planar.
Is the line at an Up level?
Y N

– Use MIM 141 to isolate the failure.

– Check the '+5 Vdc' and the '–5 Vdc' lines at the planar. (If the ideographic keyboard is installed, check the +8.5 Vdc line at the planar.)
Are the voltages correct?
Y N

A ground in the cable or keyboard could have damaged the planar.
– Check for a grounded voltage line and then replace planar 1; set the jumpers correctly on the new planar (103, 105).

– Check the '+5 Vdc' and the '–5 Vdc' lines at the keyboard end of the cable. (If the ideographic keyboard is installed, check the +8.5 Vdc line at the keyboard end of the cable.)
Are the voltages correct?
Y N

– Check for an open voltage line in the cables.

– Check the '–DATA strobe' line at the planar.
Does the line pulse when a key is held down?
Y N

Is the '-DATA strobe' line at an Up level?
Y N

– Disconnect the cable at the keyboard end.
Is the line at a Down level?
Y N

– Replace the keyboard logic PC board.

– Check the '-DATA strobe' line for a ground.
Is the '+DELAY strobe' line Down at the planar?
Y N

– Replace planar 1; set the jumpers correctly on the new planar (103, 105).

– Check the '-DATA strobe' line at the keyboard end of the cable.

A

A

Does the line pulse when a key is held down?
Y N

– Check the '+DELAY strobe' line for an open.
– Inspect the –5 Vdc, the +5 Vdc, and B07 ('–DATA strobe' line) contacts on the keyboard end of the cable.
Are the cables OK?
Y N

– Repair or replace the failing cable.

– Replace the keyboard logic PC board.

– Check the '–DATA strobe' line in the cables for an open.
Are the cables OK?
Y N

– Repair or replace the failing cable.

– Inspect the interposer.
– Replace planar 1; set the jumpers correctly on the new planar (103, 105).

– Disconnect the cable at the keyboard end.
– Check the '+DELAY strobe' line for a ground.
Is the line grounded?
Y N

– Check the '+DELAY strobe' line for a ground at the cable connector on the keyboard logic PC board.
Is the line grounded?
Y N

– Check the 'Cable Check B' line (140).

– Replace the keyboard logic PC board; set the jumpers correctly on the new PC board (142).

– Disconnect the cable at the planar.
– Check the '+DELAY strobe' line for a ground at the planar.
Is the line grounded?
Y N

– Repair or replace the cable.

– Replace planar 1; set the jumpers correctly on the new planar (103, 105).

138 (continued)

Suggested action for an intermittent problem:

- Analyze the suspected line; inspect all the connector contacts.
- Clean the pad PC board contacts (132).
- Replacement sequence:
  - Logic PC board
  - Planar 1
  - Keyboard cables

139 KEYBOARD CLICKER MINI-MAP

- Use this mini-MAP to locate a keyboard clicker problem.
- For mini-MAP example, see "Troubleshooting Aids" (212).

Conditions After Power On

- The '+8.5 Vdc' line is active.
- The '–clicker activate' line is at an Up level.

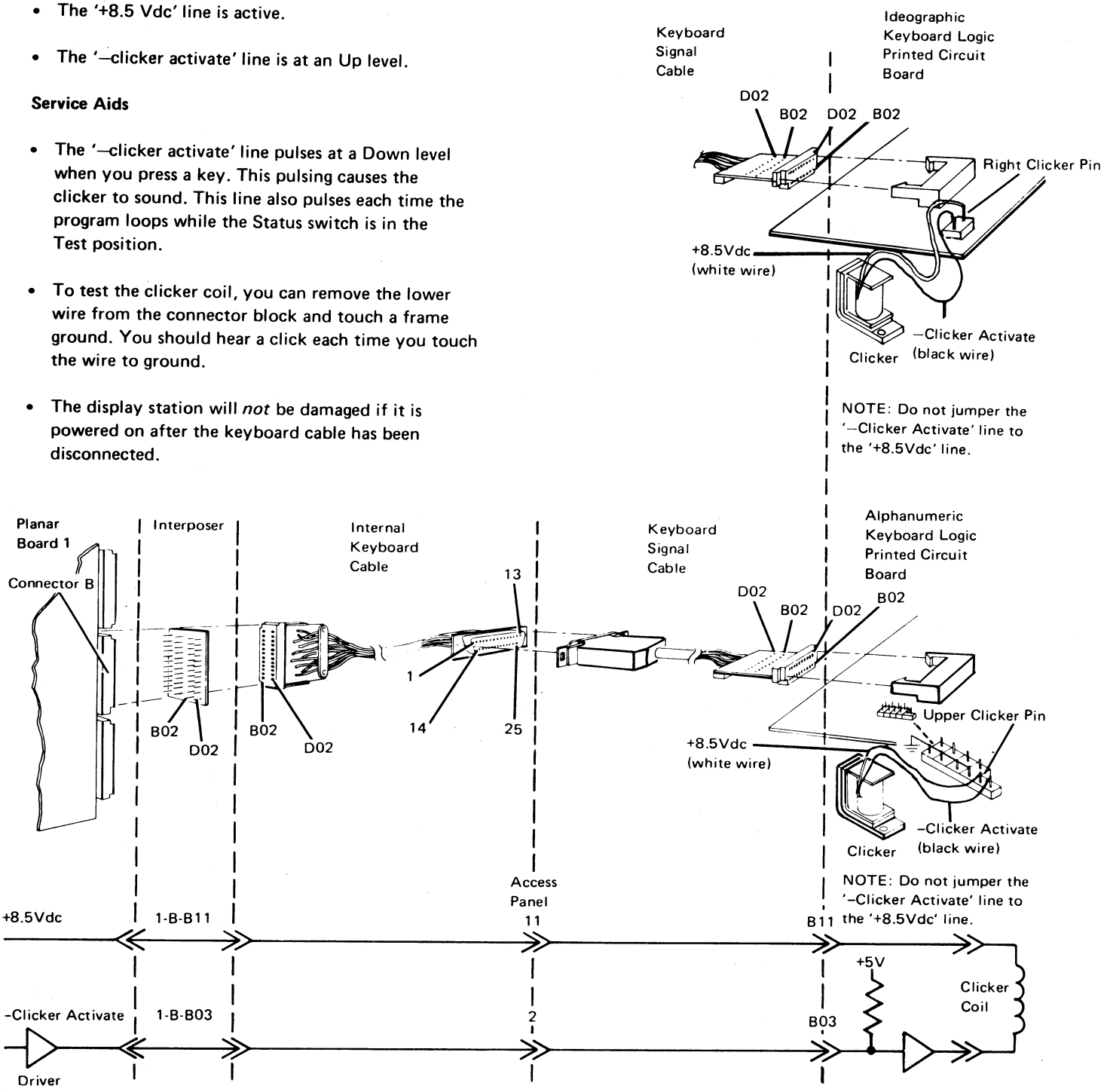
Service Aids

- The '–clicker activate' line pulses at a Down level when you press a key. This pulsing causes the clicker to sound. This line also pulses each time the program loops while the Status switch is in the Test position.
- To test the clicker coil, you can remove the lower wire from the connector block and touch a frame ground. You should hear a click each time you touch the wire to ground.
- The display station will *not* be damaged if it is powered on after the keyboard cable has been disconnected.

Tools

Connect the CE probe as follows:

- +lead–1–G–D03
- –lead–1–G–D08
- Ground–1–B–D08



139 (continued)

- Check the clicker coil and the '+8.5 Vdc' line as follows.
- Remove the black 'clicker activate' wire.

Does the clicker sound each time the (black) wire is touched to a ground pin?

Y N

- Check for +8.5 Vdc at the upper clicker pin. (On the ideographic keyboard check for +8.5 Vdc at the right clicker pin. For orientation, see diagrams in this section.)

  Is the voltage correct?

  Y N

  - Check for an open '+8.5 Vdc' line back to the planar.

  - Replace the clicker.

- Check the '–clicker activate' line (B03) at the keyboard end of the cable.

Note: When **no** key is pressed, the line should be at an Up level. If the line is not at an Up level, answer no to the next question.

Does the line pulse each time a key is pressed?

Y N

Is the line at a Down level?

Y N

Does the line pulse each time a key is pressed?

Y N

- Inspect the interposer.
- Replace planar 1; set the jumpers correctly on the new planar (103, 105).

- Check the cable for an open.

- Check the '–clicker activate' line for a ground.

- Check the keyboard end of the cable.
- Replace the logic PC board.

Suggested action for an intermittent problem:

- Analyze the suspected line; inspect all the connector contacts.

- Replacement sequence:
  - Keyboard logic PC board
  - Planar 1
  - Keyboard cables

140 KEYBOARD CABLE CHECK MINI-MAP

- Use this mini-MAP to locate an open in the cable check lines.
- For mini-MAP example, see "Troubleshooting Aids" (212).

Conditions After Power On

Both the '–cable check A' and '–cable check B' lines are at a Down level.

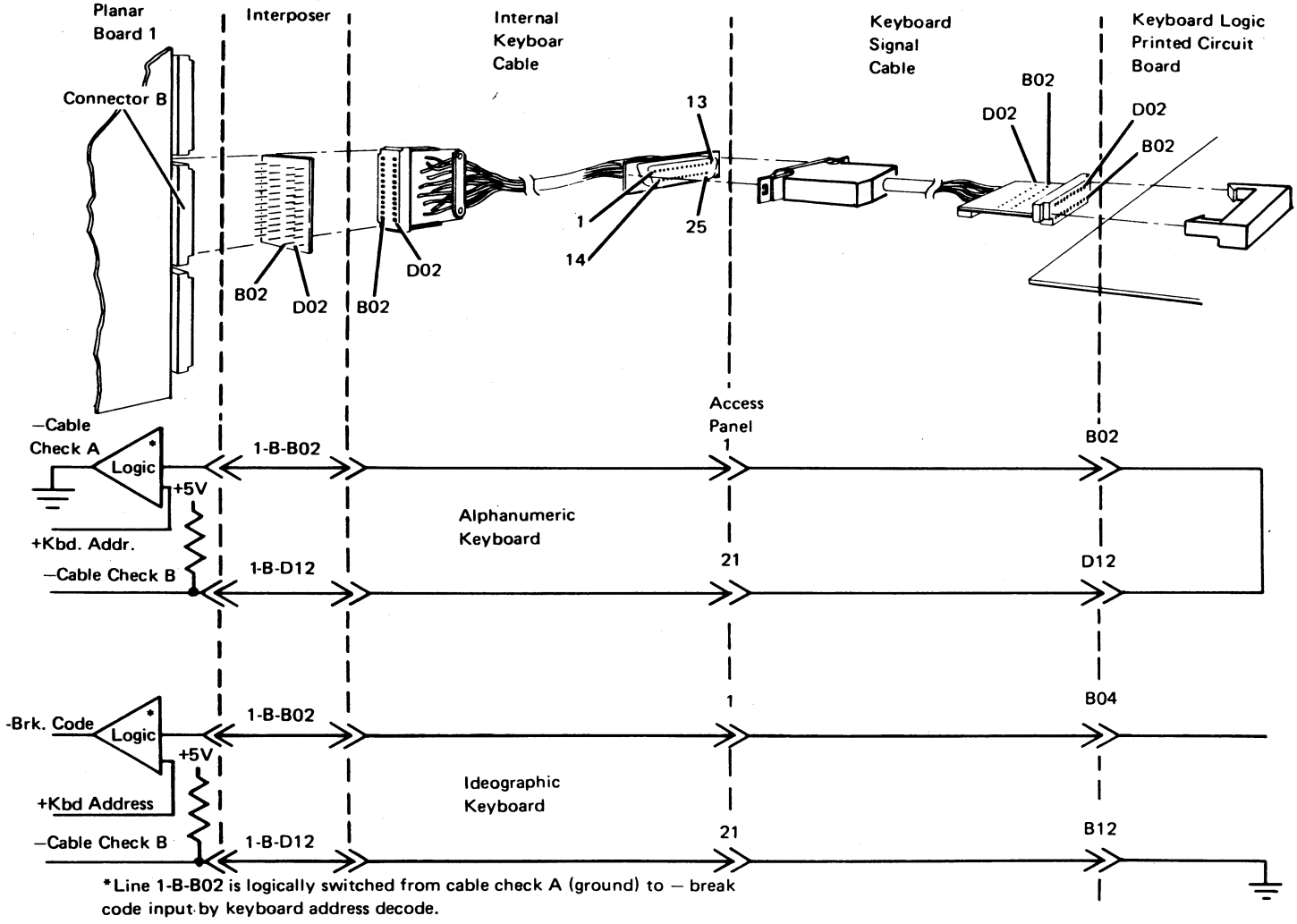
Service Aids

The display station will *not* be damaged if it is powered on after the keyboard cable has been disconnected.

Tools

Connect the CE probe as follows:

- +lead–1–G–D03
- –lead–1–G–D08
- Ground–1–B–D08



*Line 1-B-B02 is logically switched from cable check A (ground) to – break code input by keyboard address decode.

140 (continued)

– Probe '–cable check B' (D12) at planar 1.

Is the line at a Down level?

Y N

– Check for an open through the cable and keyboard logic PC board back to ground on the planar.

– Inspect the interposer.

– Replace planar 1; set the jumpers correctly on the new planar (103, 105).

Suggested action for an intermittent problem:

- Jumper B02 to D12 (alphanumeric keyboard) or Ground to D12 (ideographic keyboard).
- If the problem still occurs, replace planar 1. If the problem does not occur, the cable or keyboard logic PC board could be open.

141 KEYBOARD POR MINI-MAP

- Use this mini-MAP to locate an open or grounded '–power-on reset' (POR) line.
- For mini-MAP example, see "Troubleshooting Aids" (212).

Conditions After Power On

The '–power-on reset' line is at an Up level.

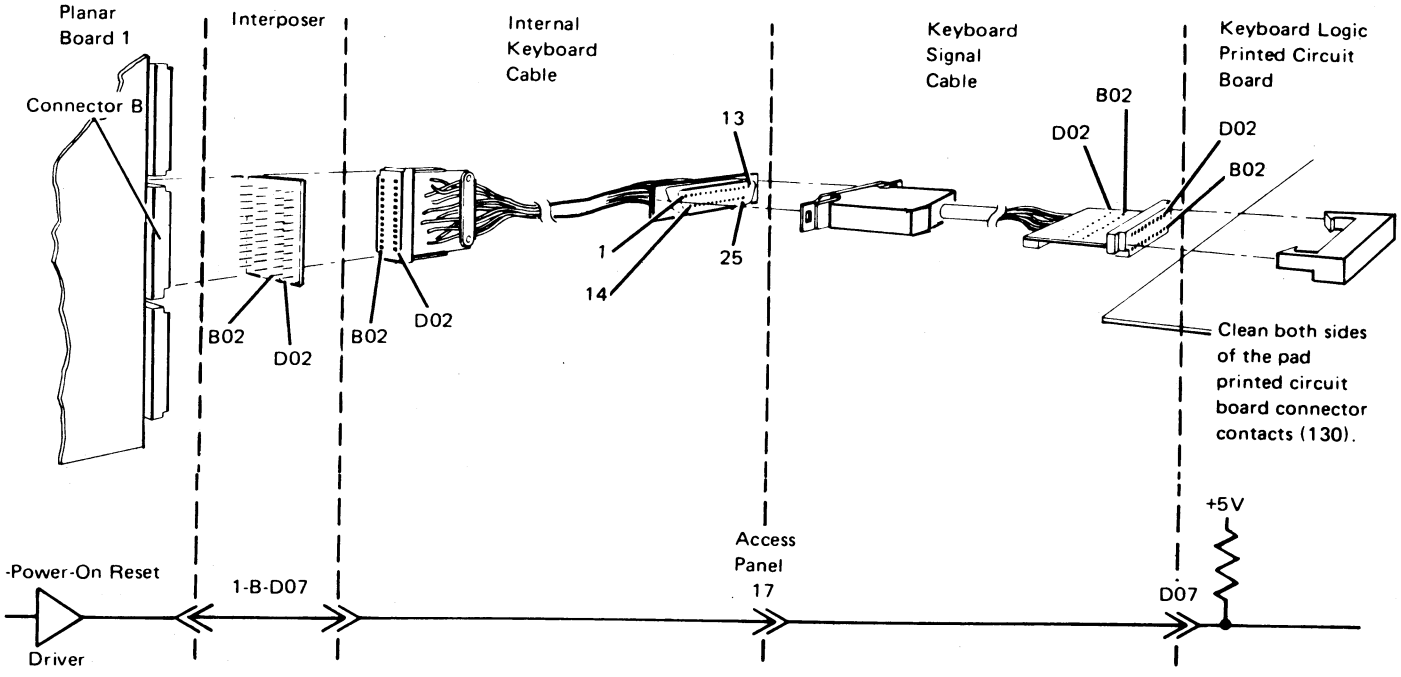
Service Aids

- The '–power-on reset' line is at a Down level for about 0.5 seconds during power on.
- The display station will *not* be damaged if it is powered on after the keyboard cable has been disconnected.

Tools

Connect the CE probe as follows:

- +lead–1–G–D03
- –lead–1–G–D08
- Ground–1–B–D08



141 (continued)

– Check the '–power-on reset' line at the planar.

Is the line at a Down level?

Y N

Does the line pulse Down for about 1 second during power-on?

Y N

– Inspect the interposer.
– Replace planar 1; set the jumpers correctly on the new planar (103, 105).

– Check the '–power-on reset' line at the keyboard end of the cable.

Are conditions the same as at the planar end?

Y N

– Check the cable for an open-circuit.

– Inspect the logic PC board socket.
– Replace the logic PC board.

– Power off.
– Remove the cable at socket B.
– Power on.

Is the line at a Down level at the planar?

Y N

– Check for a ground in the cable keyboard logic PC board.

– Inspect the interposer.
– Replace planar 1; set the jumpers correctly on the new planar (103, 105).

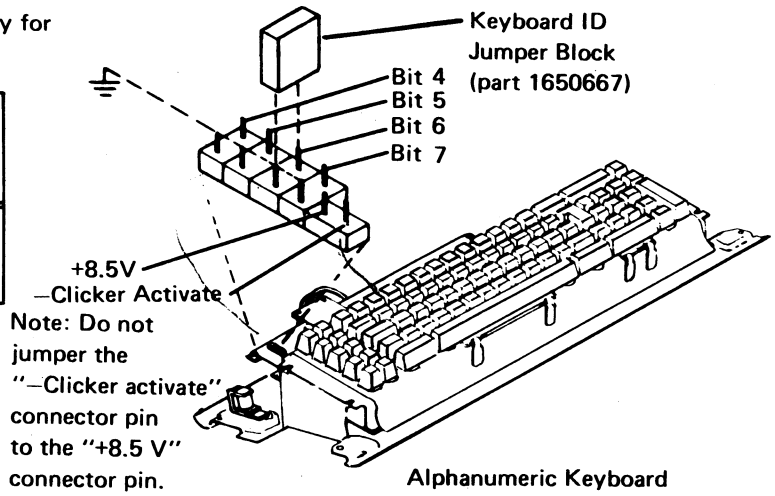
Suggested action for an intermittent problem:

- Analyze the suspected line; inspect all the connector contacts.
- Clean the pad PC board contacts.
- Replacement sequence:
  – Logic PC board
  – Planar 1
  – Keyboard cables

142 KEYBOARD IDENTIFICATION

The following shows the jumpers that are necessary for keyboard identification.

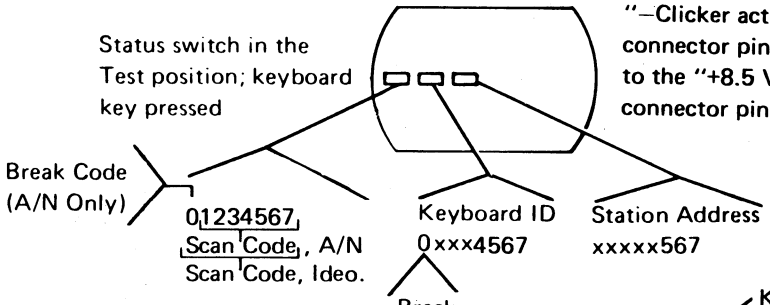
Keyboard Type	Keyboard Bit Assignment 4567
Ideographic Keyboard	0110
Alphanumeric Typewriter	0010

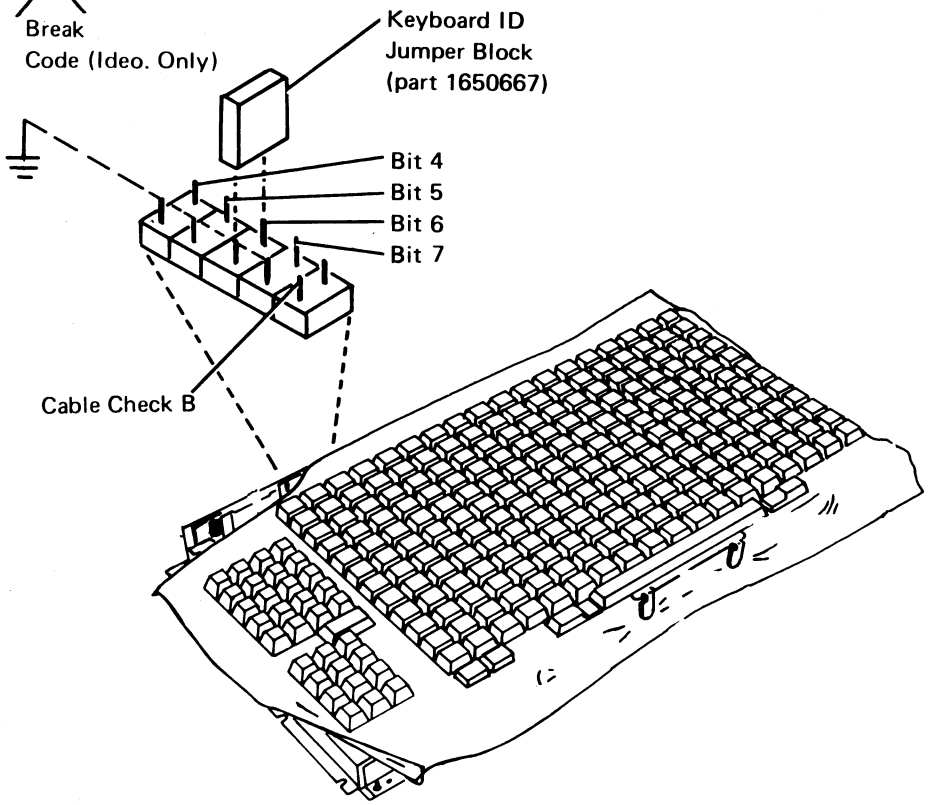


Note: Do not jumper the "–Clicker activate" connector pin to the "+8.5 V" connector pin.

Alphanumeric Keyboard

Power-On Diagnostic Display





Ideographic Keyboard

143 KEYBOARD ARRANGEMENT

The keyboard arrangement section shows the key numbers for the keyboards. The key numbers are the same as the key-position numbers in the scan code table (144).

Keyboard Template GX21-9266 (Alphanumeric Keyboard)
GX09-1006 (Ideographic Keyboard)

Display Mode	13	14	15	16	17	18	19	20	21	22	23	24	Clear
	1	2	3	4	5	6	7	8	9	10	11	12	Test Request

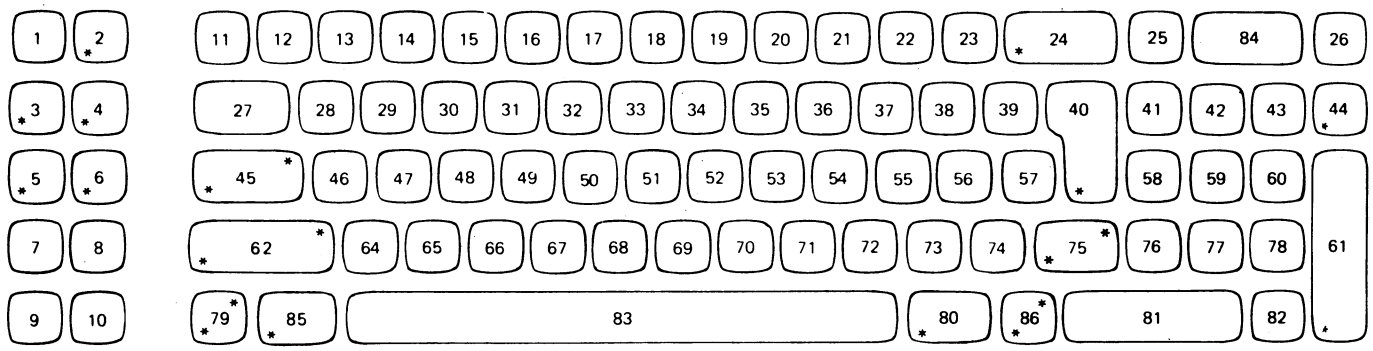
The keys in the top row on the keyboard allow you to use the command functions. When you press the CMD (command) key and then one of the top row keys, you select command functions 1 through 12 or Test Request. When you press the CMD key, then hold down a Shift key* and press one of the top row keys, you select the display mode, command functions 13 through 24, or Clear.

The keyboard template is placed in the opening above the top row of keys on the keyboard cover. The customer can change the template so that the names of the command functions on the template are the same as the names of the commands performed by the top row of keys.

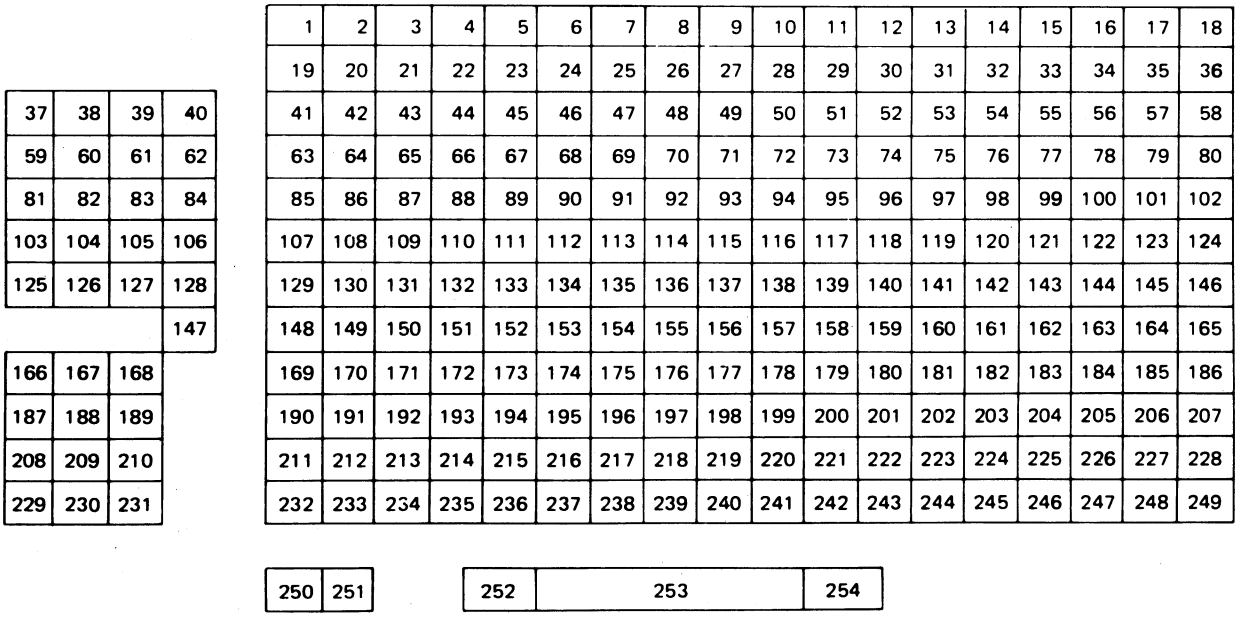
* On the ideographic keyboard, press the ALT SHIFT key.

STANDARD KEYBOARD LAYOUTS

Alphanumeric Keyboard Layout



Ideographic Keyboard Layout



144 SCAN CODE TABLES

Scan codes are a function of the physical position of the keyboard keys. The first table shows the 8-bit scan code, the hexadecimal code, and the key position for the keyboards. The * (asterisk) in scan code position 0 indicates that the key is a make/break key with a bit setting of either 0 or 1. When a make/break key is pressed, bit 0 of the code is a 0. When a make/break key is released, bit 0 of the code is a 1.

The second table gives the scan codes for the ideographic keyboard. Because this keyboard has multi-character data keys, only the key positions and their scan codes are given in the table.

144 (continued)

Alphanumeric Keyboard

Key Position	Hex Code	Scan Code 01234567	Key Position	Hex Code	Scan Code 01234567
1	7C	01111100	44	4E	01001110
2	6F	01101111	45	54	*1010100
3	6C	01101100	46	11	00010001
4	6D	01101101	47	12	00010010
5	6E	01101110	48	13	00010011
6	7D	01111101	49	14	00010100
7	71	01110001	50	15	00010101
8	70	01110000	51	16	00010110
9	72	01110010	52	17	00010111
10	73	01110011	53	18	00011000
11	3E	00111110	54	19	00011001
12	31	00110001	55	1A	00011010
13	32	00110010	56	1B	00011011
14	33	00110011	57	1C	00011100
15	34	00110100	58	44	01000100
16	35	00110101	59	45	01000101
17	36	00110110	60	46	01000110
18	37	00110111	61	4D	01001101
19	38	00111000	62	57	*1010111
20	39	00111001	63	0E	00001110
21	3A	00111010	64	01	00000001
22	3B	00111011	65	02	00000010
23	3C	00111100	66	03	00000011
24	3D	00111101	67	04	00000100
25	4B	01001011	68	05	00000101
26	4C	01001100	69	06	00000110
27	20	00100000	70	07	00000111
28	21	00100001	71	08	00001000
29	22	00100010	72	09	00001001
30	23	00100011	73	0A	00001010
31	24	00100100	74	56	*1010110
32	25	00100101	75	0C	00001100
33	26	00100110	76	41	01000001
34	27	00100111	77	42	01000010
35	28	00101000	78	43	01000011
36	29	00101001	79	7E	01111110
37	2A	00101010	80	68	01101000
38	2B	00101011	81	40	01000000
39	2C	00101100	82	4A	01001010
40	2D	00101101	83	0F	00001111
41	47	01000111			
42	48	01001000			
43	49	01001001			

144 (continued)

Ideographic Keyboard

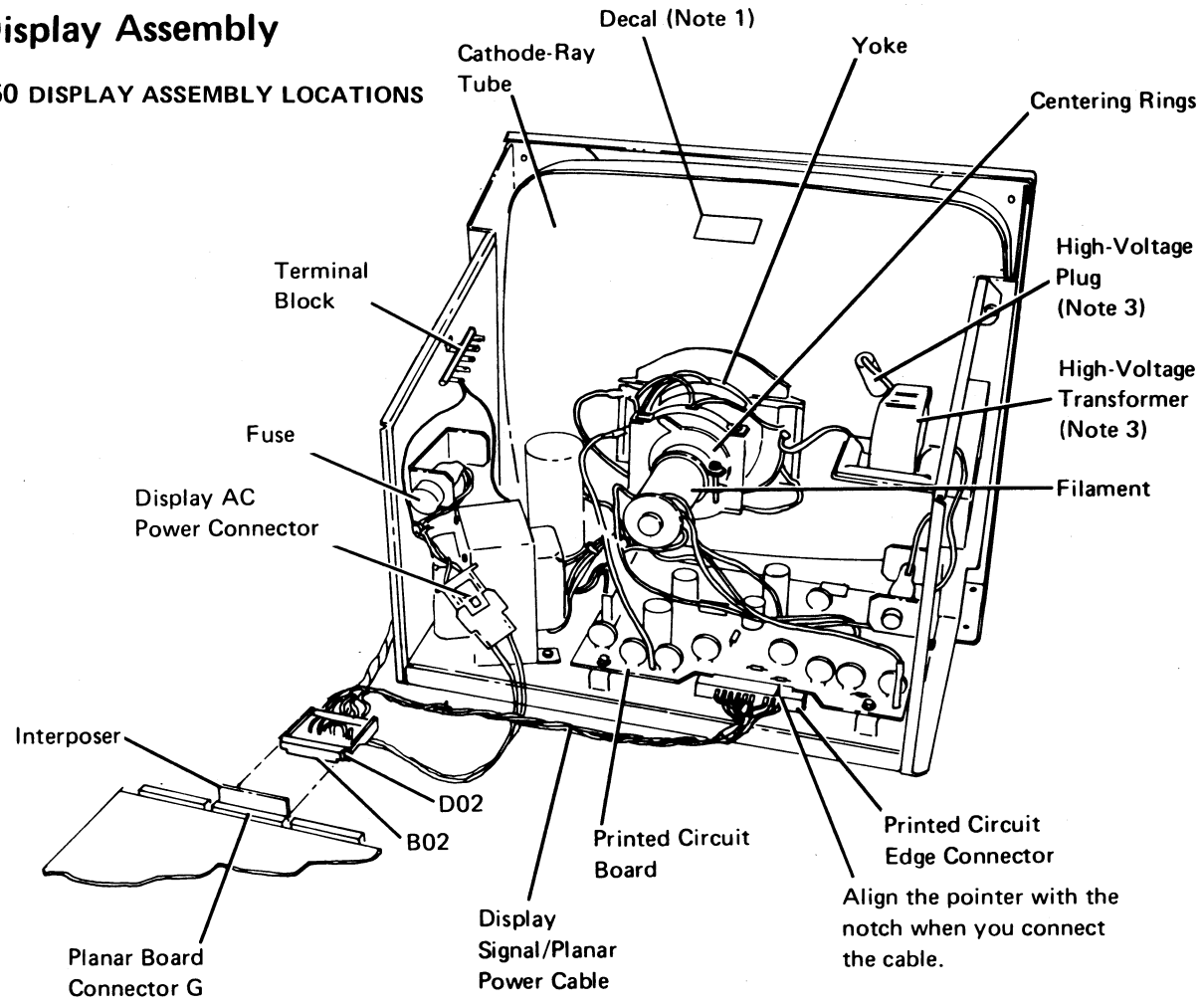
Key Position	Scan Code 01234567	Key Position	Scan Code 01234567	Key Position	Scan Code 01234567
1	11010111	48	11000110	95	11111000
2	01010111	49	01000110	96	01111000
3	10010111	50	00000110	97	10101000
4	00010111	51	11110100	98	11001000
5	11100111	52	01110100	99	11011000
6	01100111	53	10100100	100	10011000
7	10100111	54	11000100	101	01101000
8	11000111	55	11010100	102	10001000
9	01000111	56	10010100	103	11110010
10	00000111	57	01100100	104	01110010
11	11110101	58	10000100	105	10110010
12	01110101	59	11110011	106	00110010
13	10100101	60	01110011	107	11011110
14	11000101	61	10110011	108	01011110
15	11010101	62	00110011	109	10011110
16	10010101	63	11010010	110	00011110
17	01100101	64	01010010	111	11101110
18	10000101	65	10010010	112	01101110
19	11010011	66	00010010	113	10101110
20	01010011	67	11100010	114	11001110
21	10010011	68	01100010	115	01001110
22	00010011	69	10100010	116	00001110
23	11100011	70	11000010	117	11111100
24	01100011	71	01000010	118	01111100
25	10100011	72	00000010	119	10101100
26	11000011	73	11110000	120	11001100
27	01000011	74	01110000	121	11011100
28	00000011	75	10100000	122	10011100
29	11110001	76	11000000	123	01101100
30	01110001	77	11010000	124	10001100
31	10100001	78	10010000	125	11111010
32	11000001	79	01100000	126	01111010
33	11010001	80	10000000	127	10111010
34	10010001	81	11110110	128	00111010
35	01100001	82	01110110	129	11011011
36	10000001	83	10110110	130	01011011
37	11110111	84	00110110	131	10011011
38	01110111	85	11011010	132	00011011
39	10110111	86	01011010	133	11101011
40	00110111	87	10011010	134	01101011
41	11010110	88	00011010	135	10101011
42	01010110	89	11101010	136	11001011
43	10010110	90	01101010	137	01001011
44	00010110	91	10101010	138	00001011
45	11100110	92	11001010	139	11111001
46	01100110	93	01001010	140	01111001
47	10100110	94	00001010	141	10101001

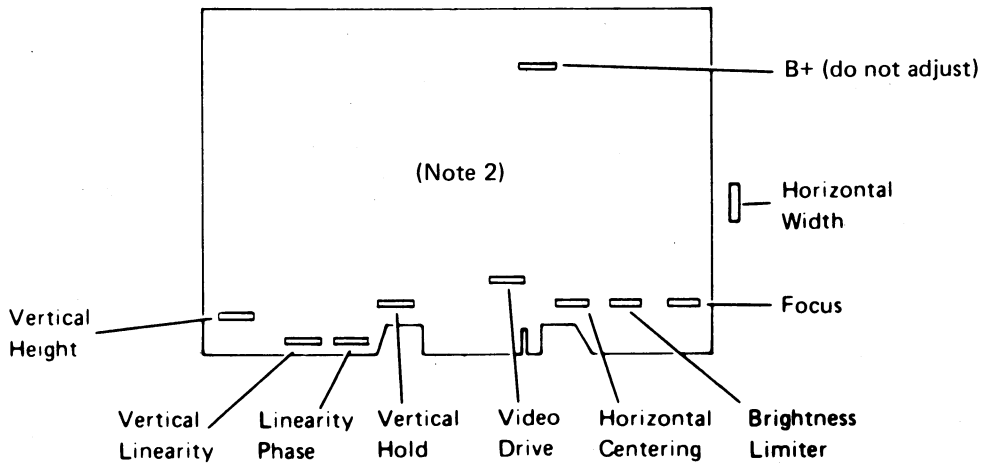
144 (continued)

Key Position	Scan Code 01234567	Key Position	Scan Code 01234567	Key Position	Scan Code 01234567
142	11001001	191	11101001	240	10001010
143	11011001	192	00011001	241	10000111
144	10011001	193	01011001	242	00100111
145	01101001	194	00101001	243	10110101
146	10001001	195	00111001	244	00110101
147	00111111	196	10111001	245	00100101
148	11011111	197	00101011	246	01010101
149	01011111	198	10001011	247	00010101
150	10011111	199	10000110	248	11100101
151	00011111	200	00100110	249	01000101
152	11101111	201	10110100	250	00111110
153	01101111	202	00110100	251	00111011
154	10101111	203	00100100	252	00000101
155	11001111	204	01010100	253	00000100
156	01001111	205	00010100	254	00000001
157	00001111	206	11100100		
158	11111101	207	01000100		
159	01111101	208	00001001		
160	10101101	209	01111011		
161	11001101	210	10111011		
162	11011101	211	01001100		
163	10011101	212	11101100		
164	01101101	213	00011100		
165	10001101	214	01011100		
166	11111110	215	00101100		
167	01111111	216	00111100		
168	10111111	217	10111100		
169	01001101	218	00101110		
170	11101101	219	10001110		
171	00011101	220	10000011		
172	01011101	221	00100011		
173	00101101	222	10110001		
174	00111101	223	00110001		
175	10111101	224	00100001		
176	00101111	225	01010001		
177	10001111	226	00010001		
178	10000010	227	11100001		
179	00100010	228	01000001		
180	10110000	229	00001100		
181	00110000	230	00001101		
182	00100000	231	00001000		
183	01010000	232	01001000		
184	00010000	233	11101000		
185	11100000	234	00011000		
186	01000000	235	01011000		
187	11111011	236	00101000		
188	01111110	237	00111000		
189	10111110	238	10111000		
190	01001001	239	00101010		

Display Assembly

150 DISPLAY ASSEMBLY LOCATIONS





Notes:

1. Refer to this decal if it is present; otherwise, use the illustration shown here for adjustment locations.
2. For adjustment descriptions, see 152 and 153.
3. The display assembly contains high voltages. Use extra caution when making internal adjustments or removing the high voltage plug.

151 DISPLAY ASSEMBLY REMOVAL AND REPLACEMENT

DANGER
The display assembly contains high voltages, and the green wire in the display assembly is *not* at ground voltage. Use extra caution when making internal adjustments or when removing the high voltage plug.

Removal

1. Power off and remove the line cord from the wall outlet.
2. Open the front and rear covers (108).
3. Disconnect the display ac power cable connector.
4. Disconnect the printed circuit edge connector.
5. Remove the two base mounting screws and the four front nuts.

DANGER
Be careful when working with the display assembly. The cathode-ray tube can implode when it is hit or falls. For personal safety, wear safety glasses.

6. Lift the display assembly from the display station housing.
7. Place the used display assembly in the shipping container so it can be returned to the branch office.

Replacement

1. Set the new display assembly in the display station.
2. Fasten the display assembly using six mounting screws.
3. Connect the printed circuit edge connector. Align the pointer on the connector with the notch in the printed circuit board (157).
4. Connect the display ac power cable (150).
5. If necessary, make the display adjustments (152 through 155).
6. Align the display assembly to allow the front cover to close properly.
7. Close the front and rear covers (108).
8. Check the gap between the bezel and the display assembly to ensure that the gap is not excessive (100).
9. If the gap is excessive, return to step 6.

Display Adjustments

DANGER
The display assembly contains high voltages, and the green wire in the display assembly is *not* at ground voltage. Use extra caution when making internal adjustments or when removing the high voltage plug.

CAUTION
Use fiber screwdriver (part 460811) for display assembly adjustments.

152 VIDEO ADJUSTMENTS

The three adjustments common to all display assemblies are:

- The brightness limiter potentiometer on the display assembly.
- The Contrast control on the control panel.
- The Brightness control on the control panel.

Some displays also have a video gain/video drive adjustment.

Brightness Limiter Potentiometer Adjustment

1. Turn the Brightness control on the control panel fully clockwise.
2. Turn the brightness limiter potentiometer on the display assembly until the retrace lines just disappear. See the raster figure (156).

Note: Too much brightness might cause poor focus.

Contrast Control and Brightness Control Adjustments

1. Run the online tests (206).
2. Select option 1 (display attributes) from the Display Verification Menu.
3. The Hs on the display screen are of both normal intensity and of high intensity. Adjust the Contrast control and the Brightness control for the best display screen image.

Video Gain/Video Drive Potentiometer Adjustment

On some display assemblies, the video gain/video drive potentiometer is used to limit the brightness of the characters. Normally, use the Brightness control on the control panel for getting the best display screen image. The video gain can also correct differences between the intensity of the horizontal and vertical lines of a character.

153 VERTICAL AND HORIZONTAL ADJUSTMENTS

Perform the appropriate vertical adjustment if:

- The characters have rapid vertical movement (hold).
- The display rolls vertically (hold).
- The display is too short (height).
- The character height is not correct (linearity or phase).

Perform the proper horizontal adjustment if:

- The screen is too narrow (width).
- The right or left margin is incorrect (centering).
- The screen shows horizontal motion (centering).

If the problem is not corrected after you have made the adjustments, replace the display assembly.

Vertical Adjustments

Each vertical adjustment could affect the others. Anytime the screen image rolls, you should adjust the vertical hold potentiometer before you continue with the other vertical adjustments.

Vertical Hold Potentiometer Adjustment

Adjust the vertical hold potentiometer to obtain a stable display (not rolling) without display distortion (flat top).

1. Set the Status switch to the Test position to display the scan code, address, and ID fields.
2. Observe the display screen while you turn the vertical hold potentiometer in each direction until the screen image rolls. Note each roll position.
3. Turn the vertical hold potentiometer to the center of its range. Do *not* allow the picture to roll. If a small adjustment causes the picture to roll up and then down, replace the display assembly.

Vertical Height Potentiometer Adjustment

This potentiometer is used to adjust the overall display screen height. The average height for the 5255 is 126 mm ± 6 mm (4.96 inches ± 0.24 inch).

Vertical Linearity Potentiometer Adjustment

This potentiometer is used to control the balanced height of the characters.

The vertical height potentiometer and vertical linearity potentiometer can affect each other. Adjust them until you get the desired result.

Linearity Phase Potentiometer Adjustment

This potentiometer is used to adjust the balanced character height between the top of the screen and the bottom of the screen.

Horizontal Adjustments

Horizontal Width Potentiometer Adjustment

The horizontal width potentiometer is used to control the width of a display. This potentiometer is adjusted at the factory to 252 mm ± 6 mm (9.93 inches ± 0.24 inch). If there is a horizontal position problem, correct the problem by adjusting the centering rings.

Horizontal Centering, Horizontal Set, or Horizontal Oscillator Potentiometer Adjustment

Adjust the horizontal centering potentiometer to center the video within the raster.

1. Turn the brightness limiter potentiometer on the display assembly until a raster appears.
2. Ensure that the raster margins are equal. See reference 155.
3. Adjust the horizontal centering, horizontal set, or horizontal oscillator to center the data within the raster.
4. Turn the brightness limiter potentiometer until the raster disappears.

154 YOKE ADJUSTMENT (150)

DANGER
The display assembly contains high voltages. Use extra care when making this adjustment.

Adjust the yoke until the display is the correct size and is aligned horizontally.

1. Loosen the yoke clamp screw on the yoke collar.
2. Place the yoke as far forward as possible against the bell part of the cathode-ray tube.
3. Turn the yoke to correct the tilted display.
4. Tighten the yoke clamp screw on the yoke collar.

Note: If the adjustment cannot be made, replace the display assembly (151).

155 CENTERING ADJUSTMENT (150)

The ring magnets, which are attached to the centering rings, are used to determine the horizontal and vertical positions of a display. If the display is tilted, do *not* adjust the ring magnets; turn the yoke (154). The following adjustments will affect each other. Adjust both rings to get the best results.

DANGER
The display assembly contains high voltages. Use extra care when making this adjustment.

1. Adjust the rear centering ring for horizontal centering. The space on the left and right margins of the display should be equal.
2. Adjust the front centering ring for vertical centering.
3. If the adjustment cannot be made, replace the display assembly (151).

Factory Adjustments

CAUTION
The following factory adjustments should *not* be attempted; they are described for your information only:

Focus Potentiometer Adjustment

The focus potentiometer is used to obtain a desired display focus. The factory adjusts the potentiometer to provide the best complete screen definition.

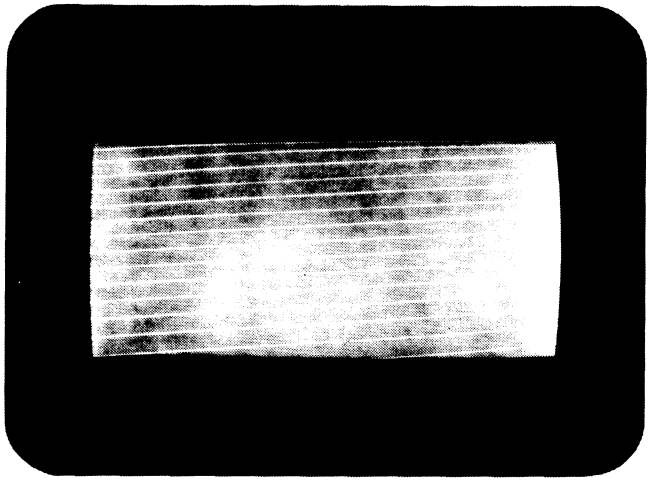
B+ Potentiometer Adjustment

The B^+ potentiometer is set at the factory with a precision meter. No attempt should be made to adjust this voltage. If the B^+ potentiometer is out of adjustment, there is a loss of display image. Because many other parts in the display assembly can cause the same symptom, the display assembly should be replaced.

156 RASTER

Raster is a condition of the display screen; the display screen area is lighted but contains no data.

Note: A reverse image display could look like a raster display. However, when you use reverse image, the indicator area is not within the lighted area of the display screen. When a raster is displayed, the lighted area of the display screen includes the indicator area.

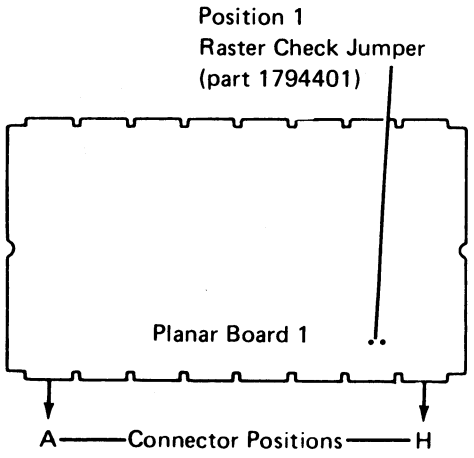


If there is a raster condition on the display screen, ensure that the raster check jumper is removed; then perform the "Video Adjustments" (152).

Raster Check

CAUTION
Power off when installing jumpers to prevent damage to the planar board.

To display a complete raster, install a jumper on jumper position 1 on planar board 1. This jumper places a solid high level voltage on the video signal line. A complete raster will check the display assembly and display signal cable.



157 DISPLAY ASSEMBLY CABLE MINI-MAP

- Use this mini-MAP to locate problems with the '+horizontal sync', '–vertical sync', and '+video' lines.
- For mini-MAP example, see "Troubleshooting Aids" (212).

Conditions After Power On

Each line is pulsing.

CAUTION
Do not power on the display station while the display signal/planar power cable is disconnected unless the display ac power is also disconnected.

Service Aids

- Open lines continue to pulse because of feedback from the display assembly. When probing for an open line, disconnect the display ac power connector (150).
- The power supply supplies power through connector G on the planar.
- Planar 1 supplies signals to the display assembly. (The display assembly has its own power supply.)

Dark Screen

- The raster check jumper (156) may be installed to force a high video signal that lights the display screen.
- A video or horizontal sync failure causes a dark screen.

Vertical Rolling, Overlapped Lines of Data, or Unstable Display

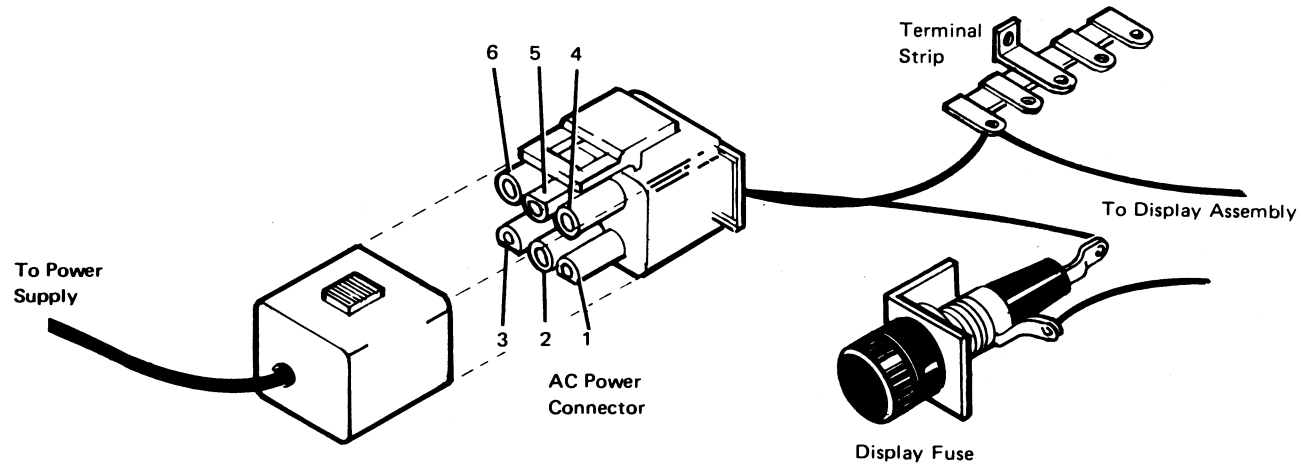
- Check the horizontal and vertical lines for an open.
- Check the adjustments (153).

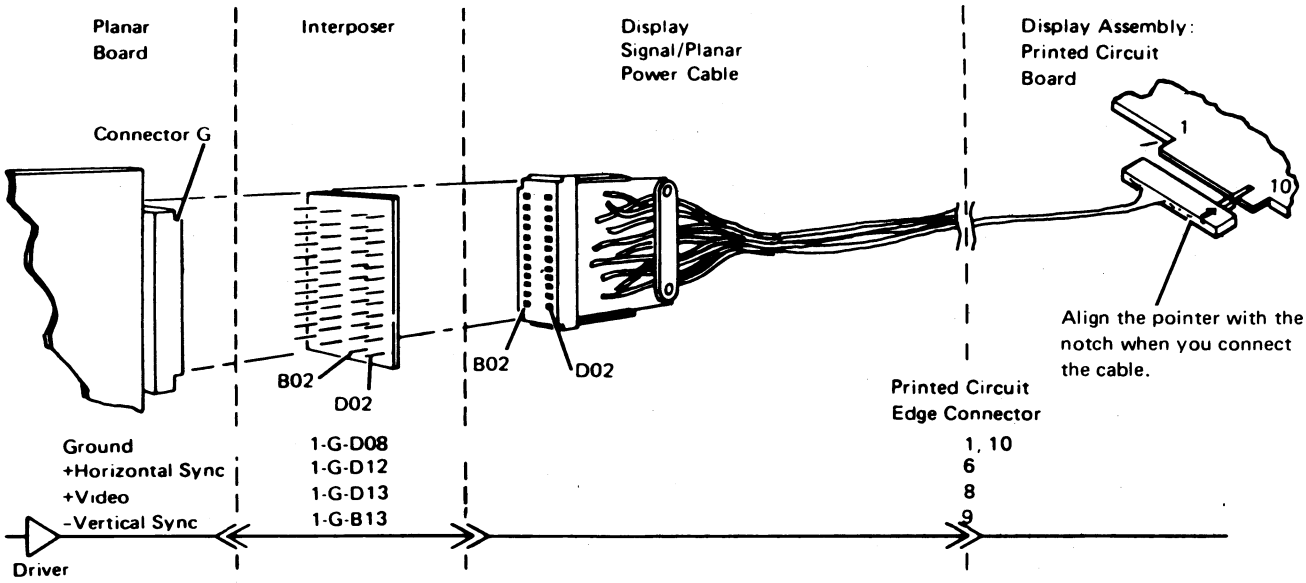
Tools

Connect the CE probe as follows:

- +lead–1–G–D03
- –lead–1–G–D08
- Ground–1–B–D08

157 (continued)





157 (continued)

– Trace the signal lines indicated in the diagram.
All signals come from the planar; however, the display will cause an open line to continue to pulse at a high enough level to trigger the CE probe.
– Power off.
– Disconnect the display ac power connector (150).
– Power on.
– Check the signal at the planar.

Note: The Brightness control must be turned up (clockwise) all the way to make the video signal large enough to trigger the CE probe.

Is the line pulsing?
Y N

– Power off.
– Disconnect the cable at the display.
– Power on.
Does the line pulse now?
Y N

– Check the cable for a grounded signal line.
Is the cable OK?
Y N

– Repair or replace the cable.

– If the failing line is +Video (1–G–D13), check that the brightness control is functioning correctly (111, circuit A).
– Replace planar 1; set the jumpers correctly on the new planar (103, 105).

– Replace the display.

Is the line pulsing at the display?
Y N

– Check the cable for an open.

Is there any other line that has not been checked?
Y N

– Power off.
– Reconnect the display ac power connector (150).
– Power on.
– Make adjustments if applicable (153, 154).
– Replace the display assembly.

– Repeat this procedure for the other line.

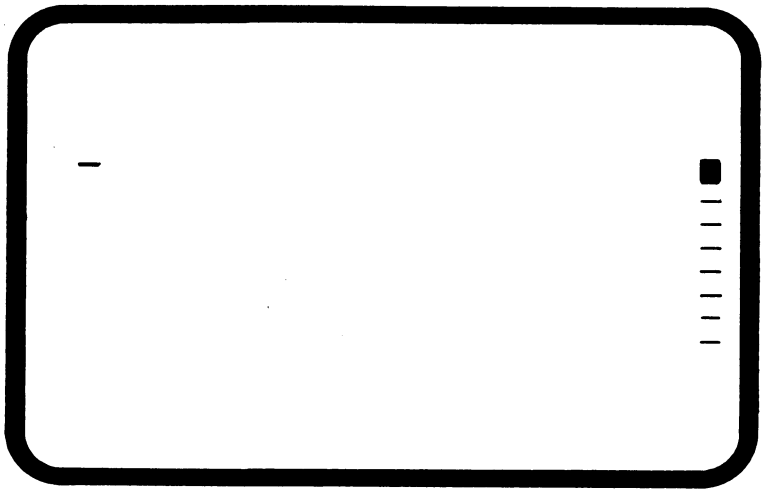
Suggested action for an intermittent problem:

- Analyze the suspected line; inspect all the connector contacts.

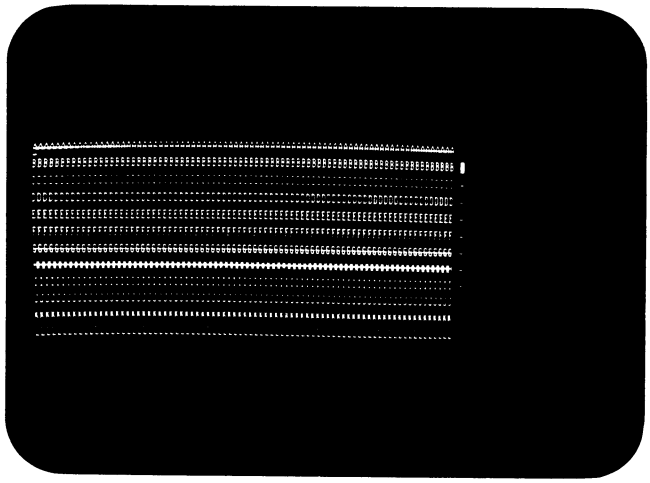
- Replacement sequence:
  – Display assembly
  – Planar 1
  – Display signal/planar power cable

158 DISPLAY SCREEN EXAMPLES

Normal screen (free key mode):

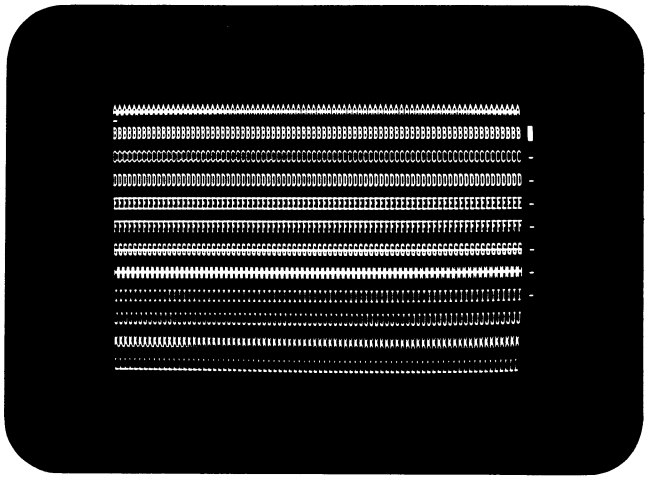


Display not centered

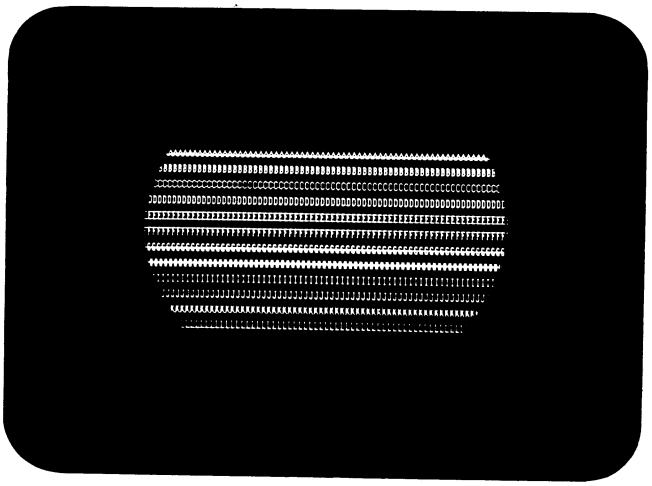


158 (continued)

Display size not correct (expanded vertically)



Characters missing only in the corners



System Cable

170 CUSTOMER SYSTEM CABLE SIGNAL QUALITY CHECK

CAUTION
All of the work stations will be taken off line while the customer system cable signal quality check is being performed.

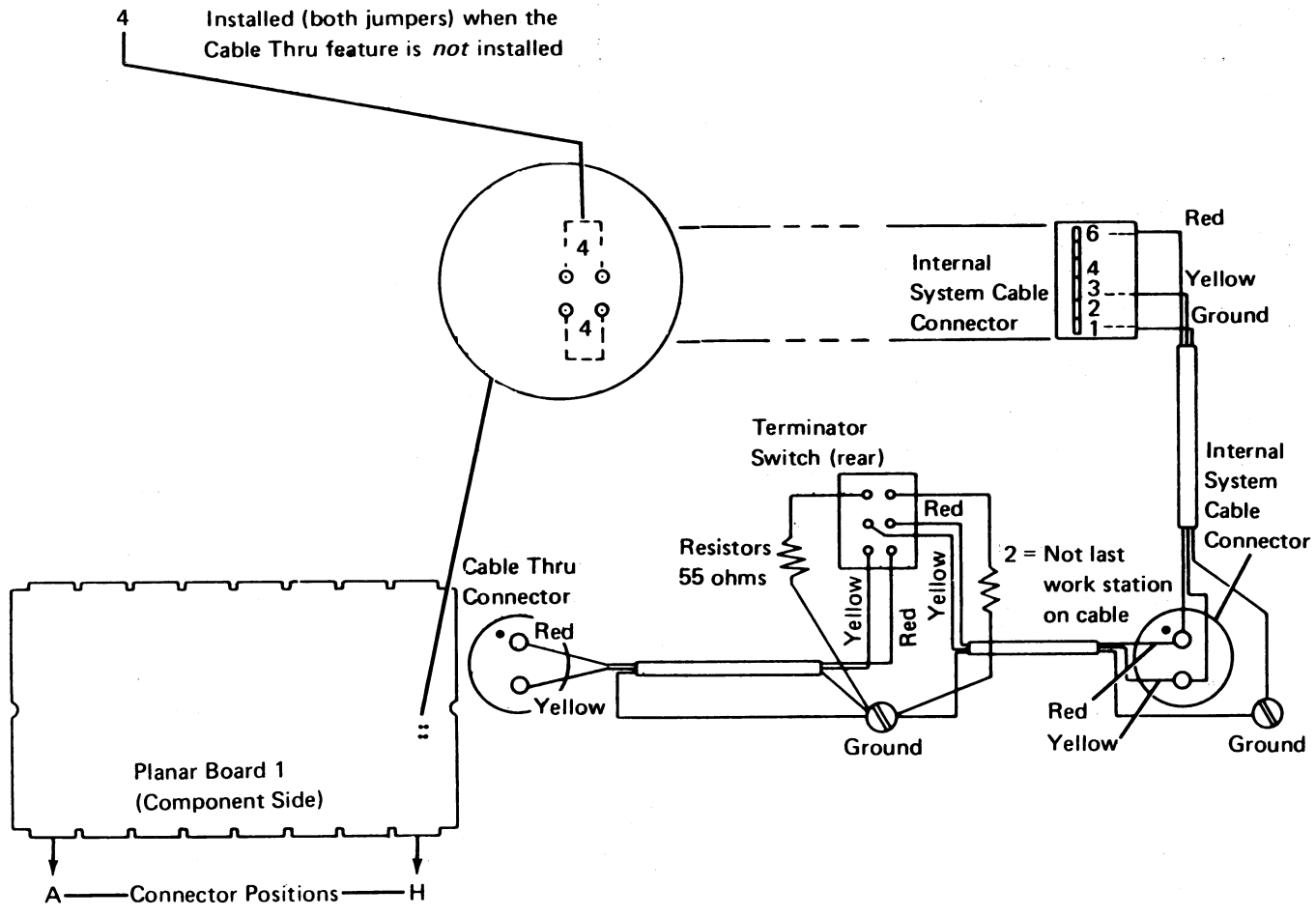
The customer system cable signal quality check is a controller diagnostic procedure. Information on this signal quality check is located in the controller documents. If you are not trained on the controller, call for a service representative who is trained on the system.

171 INTERNAL SYSTEM CABLE AND TERMINATOR SWITCH

The two jumpers on jumper position 4 of planar board 1 must be removed if the Cable Thru feature is installed on the display station.

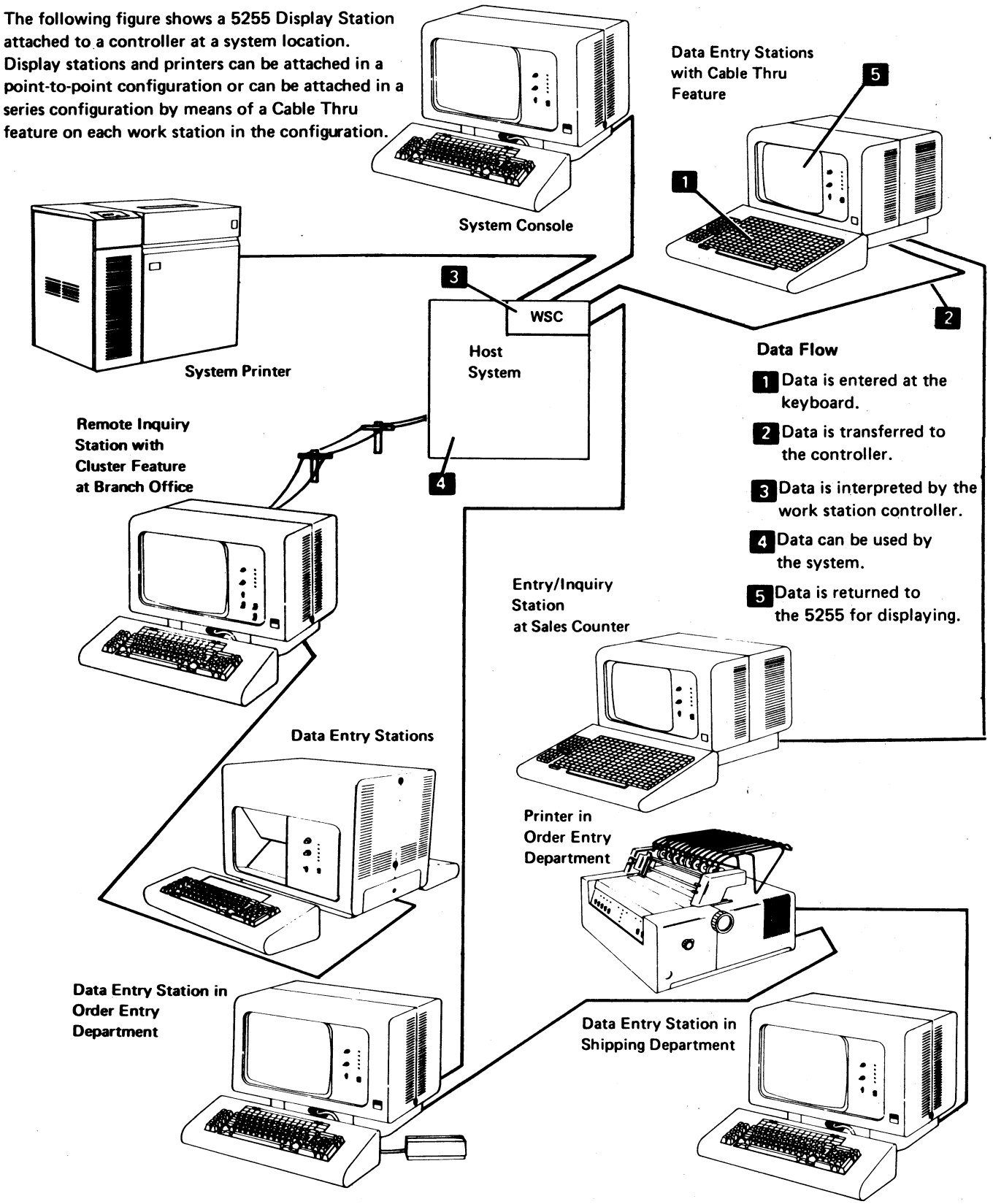
The terminator switch (Cable Thru feature only) on the access panel has a position 1 and position 2. *Position 1* stops the communications signal and completes the circuit. The last work station on the line must have the terminator switch set to position 1; all other stations on the line must have the terminator switch set to position 2. *Position 2* permits the communications signal to flow through the display station to the next work station.

Note: Do not leave the system cable disconnected when servicing the display station with the Cable Thru feature. Other devices are taken offline when this cable is disconnected. You must remove the display assembly (151) to service the terminator switch.



172 DISPLAY STATION CONFIGURATION

The following figure shows a 5255 Display Station attached to a controller at a system location. Display stations and printers can be attached in a point-to-point configuration or can be attached in a series configuration by means of a Cable Thru feature on each work station in the configuration.



173 STATION PROTECTOR

On the IBM 5255 Display Station, the station protector is a built-in standard feature.

The station protection circuitry requires no maintenance; if it is faulty, this can result in failure of planar 1.

Other 5250 work stations may use separate station protectors. For more information on them, see the *IBM 5250 Information Display System* (Ideographic Language Implementation) *Planning and Site Preparation Guide,* GA09-1628.

Lightning Protector

The lightning protector protects the planar from voltage peaks induced by electrical discharges, including lightning, and electrical noise within factories or offices. The following procedure can be used to check the lightning protector.

Note: Ensure that a lightning protector is installed on the new planar if a lightning protector was on the planar being replaced.

The cables to the lightning protector (both at the planar board and the internal system cable) must be disconnected before the checks are made. This will disconnect the display station from the system but will not disconnect other work stations in a cable-thru string.

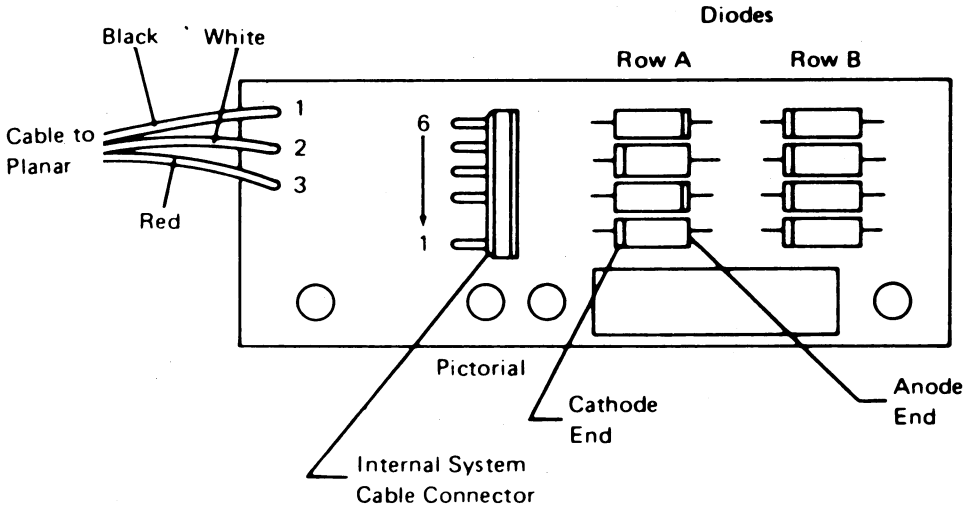
DANGER
Never hold or touch cables or connectors during an electrical storm.

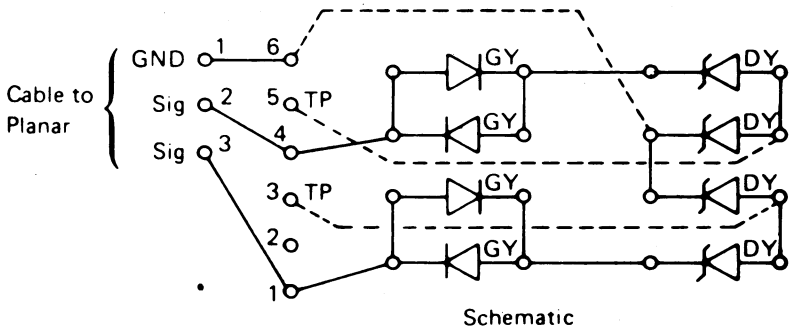
1. Visually check the lightning protector for broken wires or land patterns.

2. Use only CE meter part 1749231. Use the R x 100 scale.
   a. Check row A.
      - Check both the top and bottom diodes with the black lead connected to the anode and the red lead connected to the cathode. The resistance should be 1K to 4K.*
      - Check both the top and bottom diodes with the black lead connected to the cathode and the red lead connected to the anode. The resistance should be 1K to 4K.*
   b. Check row B.
      - Check each diode with the black lead connected to the anode and the red lead connected to the cathode. The resistance should be 1K to 4K.*
      - Check each diode with the black lead connected to the cathode and the red lead connected to the anode. The CE meter should indicate an open circuit.

   * If either diode in the pair is open, the resistance will indicate an open circuit in one direction.

Lightning Protector





Schematic

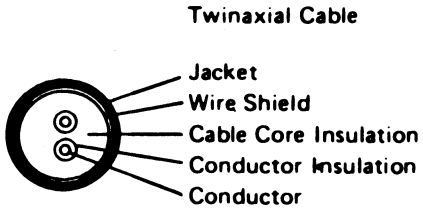
The dotted lines show land patterns on the back of the PC board.

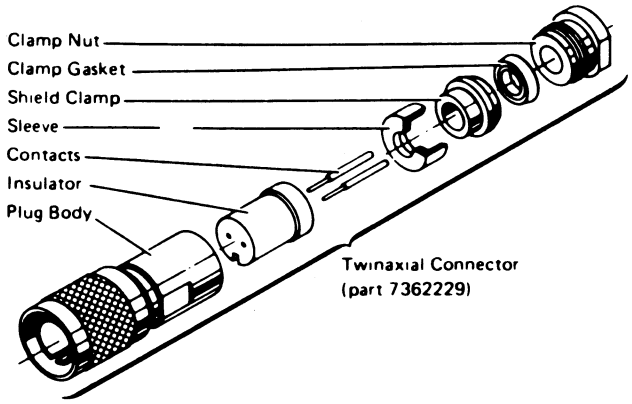
174 CABLE ASSEMBLY PROCEDURES

Assembling and maintaining the customer system cable should be done by the customer. However, if aid is requested, use the following procedures to assemble the cables.

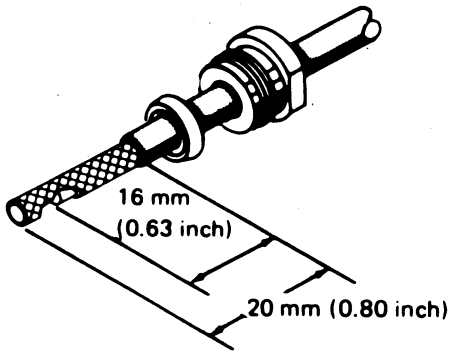
Twinaxial Cable

1. Ensure that all parts are present. Look at the figure below for location of the cable layers.

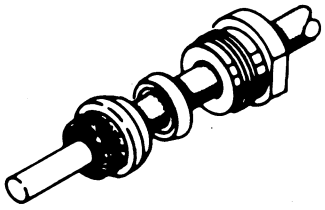




2. Cut the end of the cable squarely. Then slide a clamp nut and clamp gasket over the cable jacket and trim the jacket to the dimensions given. Push the wire shield back to expose the inner insulation core, and cut the core and conductors to the dimension shown (16 mm [0.63 inch]). Slide the wire shield back over the core, and taper it to a point for ease of shield clamp assembly in step 3.



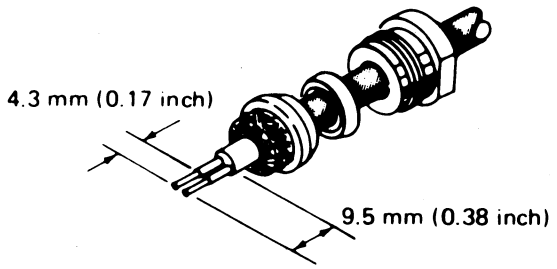
3. Slide the shield clamp over the shield so that its inner shoulder touches the cable jacket. Then, fold the shield back over the shield clamp and trim the shield as shown.



Note: Place the shield wires over the shield clamp uniformly to ensure a good radio frequency connection of the shield, and to prevent breaking the strands or the shield.

174 (continued)

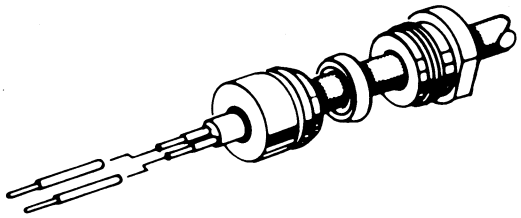
4. Cut the cable core and the conductor insulation to the dimensions shown. Do *not notch the conductors or the insulation.* If the braid is separated, trim the shield again as in step 2.



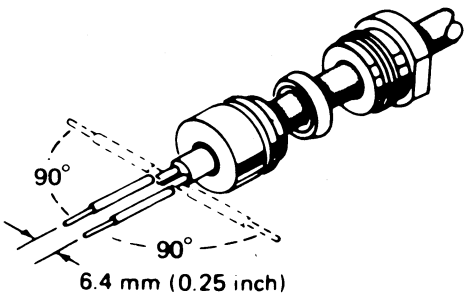
5. Slide the sleeve over the cable core and press the sleeve against the shield wires.

   Using minimum heat, solder the contacts to the conductors.

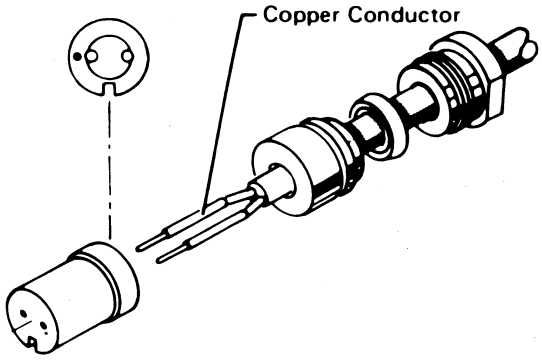
   CAUTION
   Clean off any excess solder.



6. Bend the conductors and the contacts out at 90° to the cable. Then bend the conductors back to parallel (approximately 6.4 millimeters [0.25 inch] between conductors).

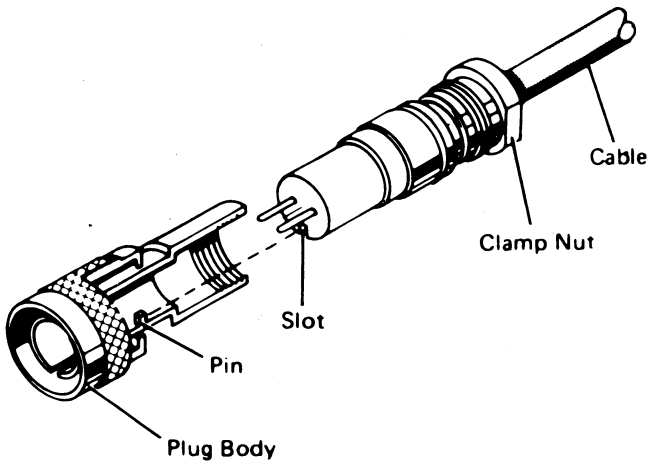


7. Slide the insulator over the contacts and the cable so that the insulator touches the sleeve. Press all the parts together. To ensure correct polarity, the contact on the bare copper conductor of the cable must go into the insulator hole that has a dot next to it.



8. Align the slot in the insulator with the pin inside the plug body. Insert the assembly into the plug body. Tighten the clamp nut with 5.7 to 6.8 N·m (50 to 60 inch lbs) torque.

   CAUTION
   Do not allow the cable and plug body to twist as the clamp nut is tightened.



9. Check for shorts between the conductors and between each conductor and the plug body.

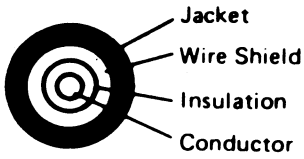
174 (continued)

Coaxial Cable

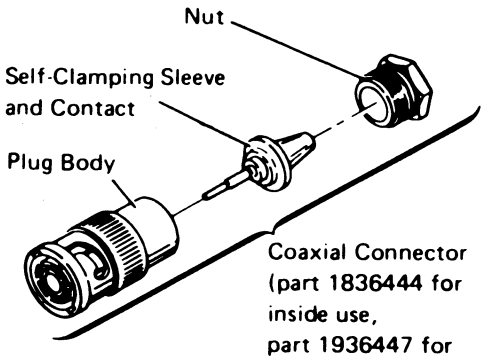
If your installation has coaxial cable (part 323921 for inside use or part 5252750 for outside use), use the following procedures to attach it to the connectors.

1. Ensure that the connector has all of the parts needed. Look at the Figure below for location of the cable layers.

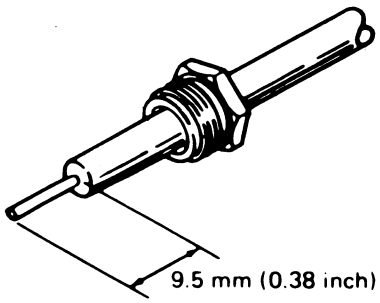
Coaxial Cable



Coaxial Connector

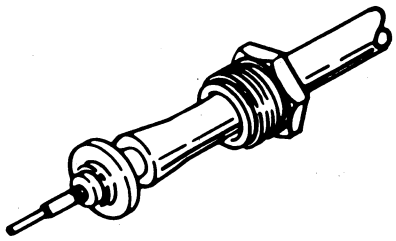


2. Cut squarely through the jacket, shield, and insulation, to show 9.5 millimeters (0.38 inch) of the conductor. Slide the nut onto the cable.



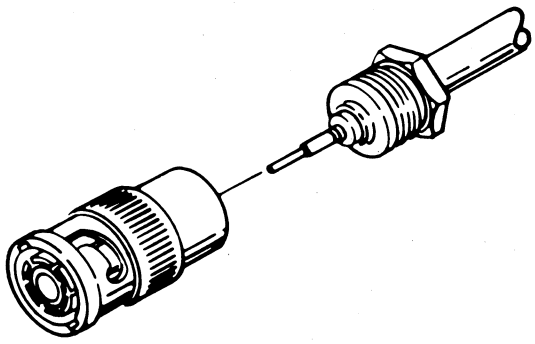
3. Insert the conductor into the tapered, self-clamping sleeve and contact; force the edge of the self-clamping sleeve between the insulator and shield until insulation is well onto the taper. Solder the conductor to the contact at the solder hole.

CAUTION
Remove the extra solder from the outside of the contact.



4. Fit the contact into the plug body; screw the nut into the body, to bind the jacket and shield tightly against the self-clamping sleeve.

CAUTION
Do not let the cable twist as the nut is tightened.



5. Check for short circuits between the plug body and the conductor.

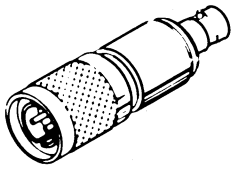
174 (continued)

Twinaxial-Coaxial Adapter

The twinaxial-coaxial cable adapter is available to give the customer (who has coax cables installed for a different system) a way to use coax cables with IBM 5250 work stations and a host system. The adapter must be used at both ends of each coaxial cable. Some systems may not support the use of coaxial cable with the adapter. Consult the *Installation Manual-Physical Planning* or *Planning and Site Preparation Guide* for the host system.

When the adapter is used the following restrictions apply:

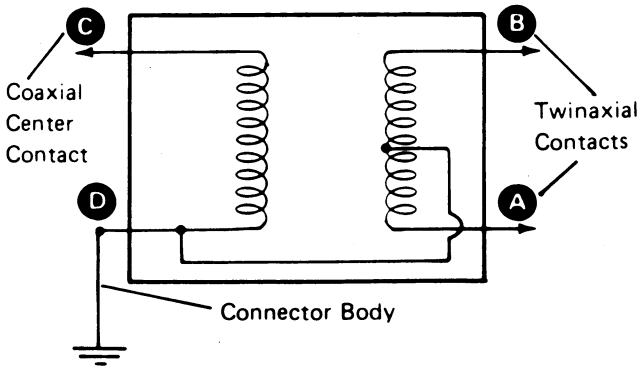
- The cable length between the controller and the first attached work station must not exceed 610 meters (2000 feet).
- When using the Cable Thru feature, no more than two work stations may be attached to a single port, and the second attached work station must be connected to the first by twinaxial cable. The cable length between the first and second work station must not exceed 30 meters (100 feet).



Twinaxial-Coaxial Adapter (part 7363102)

Adapter Service Check

Below is a table and Figure showing the maximum permissible dc resistances in the twinaxial coaxial adapter.



Measure	Maximum ohms
A to B	1.0
A to D	0.5
B to D	0.5
C to D	0.8

Cable Labeling

To assist in installation and to avoid confusion, label each end of the cable. Each label should include information that identifies:

1. The unit to which the end being labeled is to be connected.
2. The unit to which the other end is to be connected.
3. The location of the other end of the cable.
4. The port into which you will plug the cable.

Also, it is often an aid to supply the telephone extension number located near the other end of the cable.

Tests of Cabling After Installation

Installation of cabling should include tests after installation to ensure that there are no problems, no high-resistance connections, and that the circuit is in balance should ensure there are no:

1. Open circuits in each conductor or shield.
2. Short circuits between conductors of the same pair.
3. Grounds on each conductor, either between a conductor and a shield or between a conductor and a grounded object.
4. Reversed polarities (twinaxial cable only).

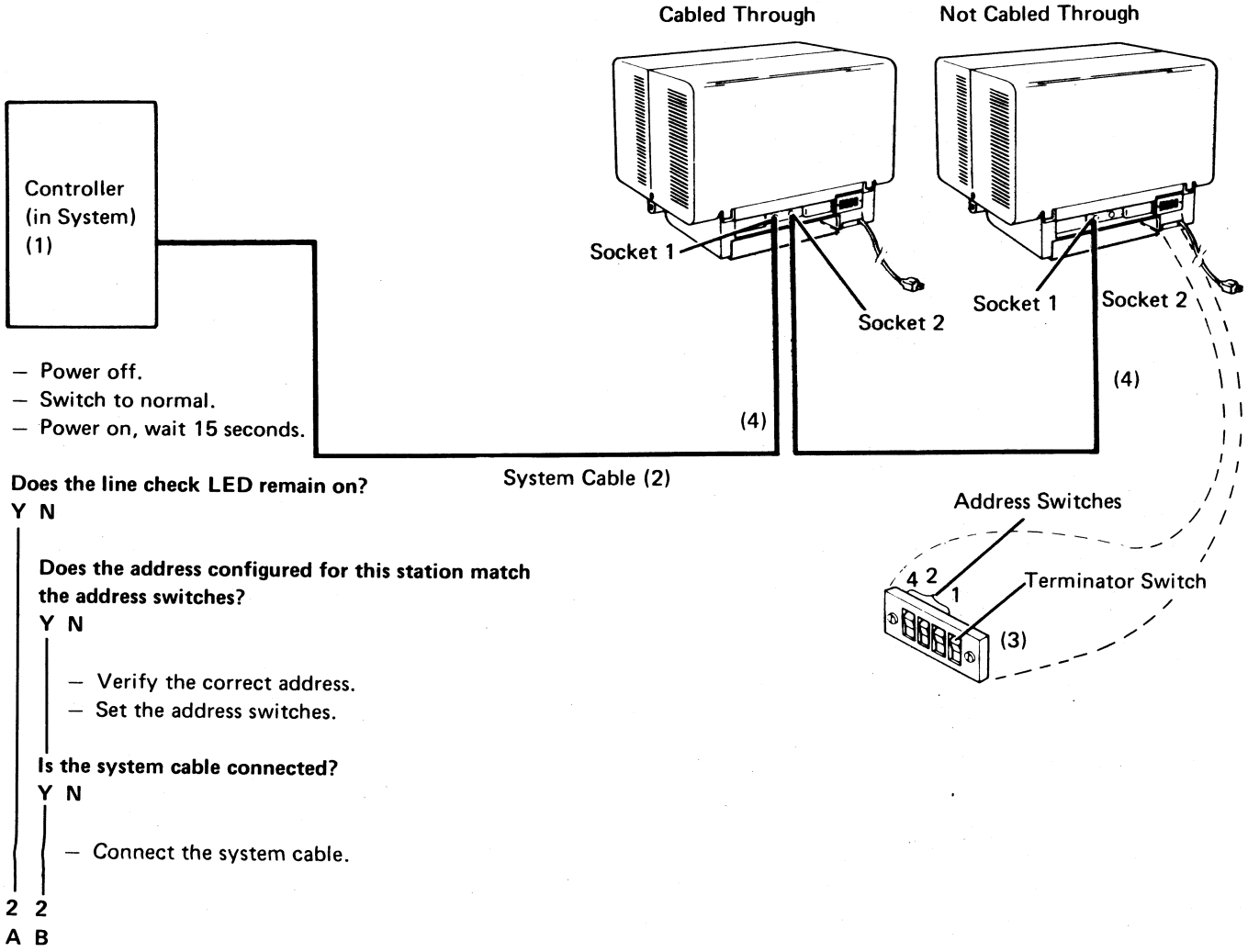
MIM 175 SYSTEM NETWORK MINI-MAP

Use this mini-MAP to isolate a communications problem with the system.

Conditions After Power-On

Service Aids

1. The system may not be configured for this station.
2. The system cable could possibly be grounded, open, or connector not installed correctly.
3. The terminator switch could possibly be set to '1' on a work station between this station and the controller (171).
4. The system cable could possibly be connected to socket 2 instead of socket 1.



– Power off.
– Switch to normal.
– Power on, wait 15 seconds.

Does the line check LED remain on?

Y N

Does the address configured for this station match the address switches?

Y N

– Verify the correct address.
– Set the address switches.

Is the system cable connected?

Y N

– Connect the system cable.

2 2
A B

A B
2 2

Is the internal system cable connected? (103)
Y N

– Connect the internal system cable.

– Remove the internal system cable.
– Check the internal system cable for grounds, opens, or shorts.

Is the internal system cable OK?
Y N

– Repair/replace internal system cable.

– Reconnect internal system cable.
– Check that the system/controller is powered up and polling this station. (No messages pending for this station on the console.)

Is the controller polling? (The controller is polling if the Line Sync indicator is on.)
Y N

– This display station is operating correctly for the symptoms described. Inform the system operator that the controller is not polling.

– Check that the terminator switch is set correctly. See Item 3 of service aids. If no station is between this station and controller or if terminator switch is set correctly – do system cable check.
– Check system cable for grounds, opens, shorts (174).

Is the system cable OK?
Y N

– Inform customer of system cable problem.

– Check jumpers.
– Replace Planar 1 (103, 104, 105).
– Replace Planar 2 (103, 104, 105).

– Check terminations on the Cable Thru feature; not more than one display station should be terminated.
– Check system cable by method 1 or 2.

1. Optional resistance check. (Refer to "Optional Resistance Check" in this section.)

2. Customer system cable signal quality check (170).

Is the network OK?
Y N

– Inform customer of system cable problem.

– Replace Planar 1 (103).

Optional Resistance Check

The continuity of the system cable may be checked with the controller power off as follows:

– Disconnect the system cable at the display station.

– Measure the resistance at the end of the system cable.

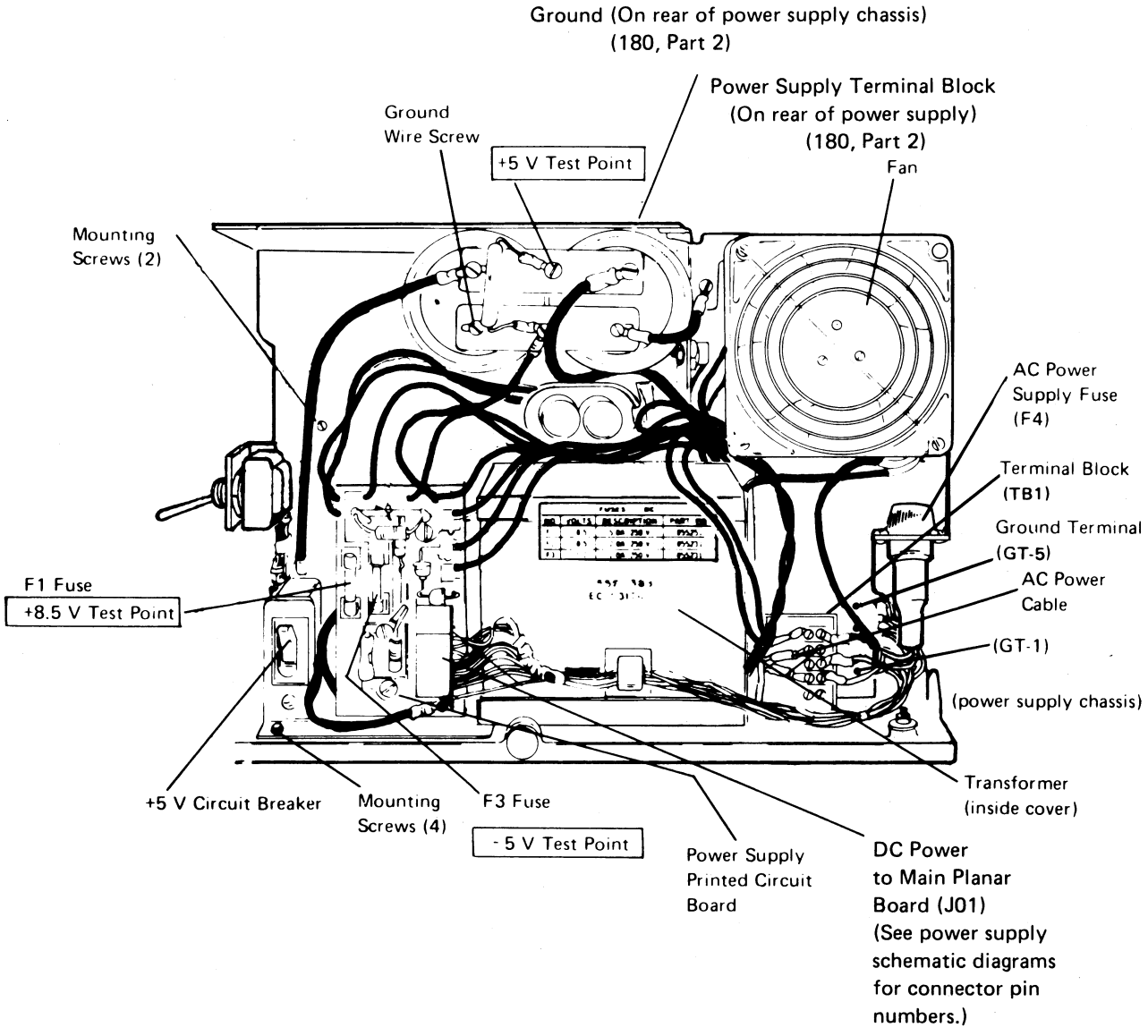
The resistance from signal wire to the shield should be about 55 to 130 ohms (55 + 5 ohms per 100 meters of cable) or (55 + 15 per 1000 feet of cable).

The resistance between signal wires should be about 110 to 210 ohms (110 + 7 ohms per 100 meters of cable) or (110 + 20 per 1000 feet of cable).

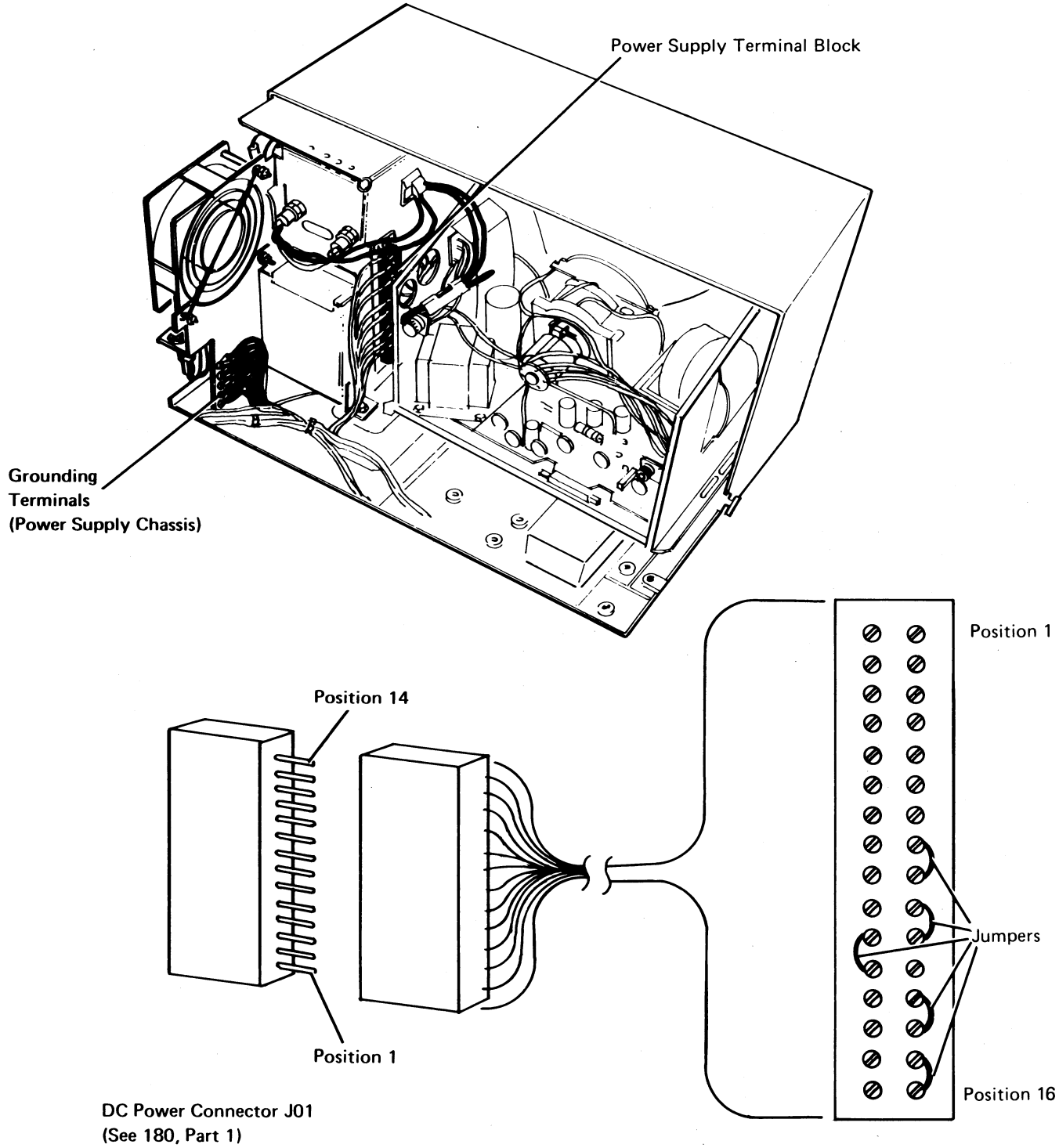
Note: Any station on the same system cable between this station and the controller must have its terminator switch set in position 2.

Power Supply

180 POWER SUPPLY LOCATIONS (Part 1)

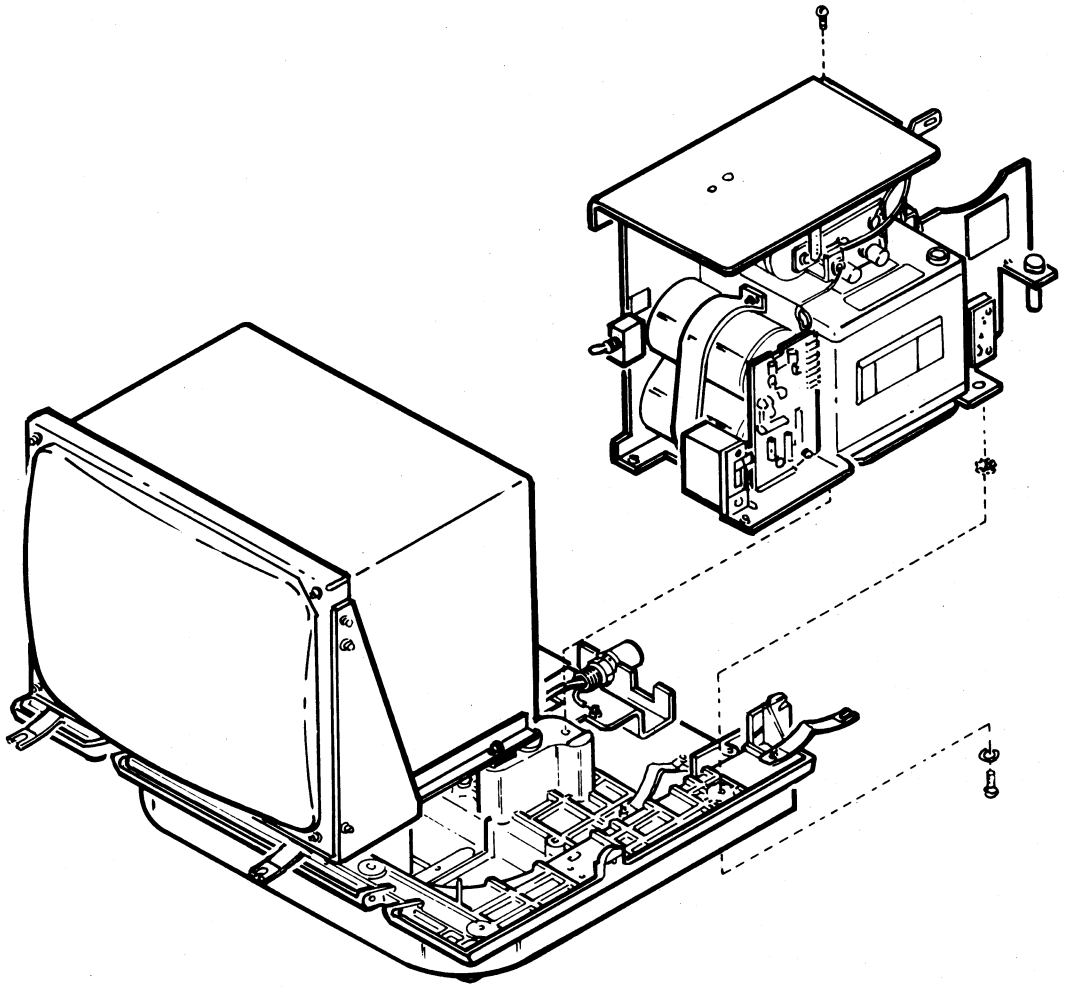


180 POWER SUPPLY LOCATIONS (Part 2)



DC Power Connector J01
(See 180, Part 1)

181 POWER SUPPLY REMOVAL AND REPLACEMENT



181 (continued)

CAUTION
Place the display station away from the edge of the table to prevent it from falling, and do not tip the machine on its back or side when removing the power supply.

1. Power off.
2. Disconnect the line cord from the customer outlet.
3. Open the front and rear covers.
4. Disconnect the display ac power connector, the dc power to the planar connectors (J01), and the ac power cable to the Power switch at TB1-1 and TB1-2.
5. Using a socket tool, remove the four mounting screws from the power supply.
6. Move the power supply enough to allow you to remove the two terminal-block holding screws and remove the terminal block with wires connected; keep to reinstall with the new main power supply.
7. Lift the power supply from the display station housing.
8. Install the new power supply. Place the used power supply in the shipping container for return to the branch office. Fill out the failure analysis tag.
9. Reinstall the terminal block removed in step 6.
10. Fasten the power supply with the mounting screws.
11. Reconnect the cables.
12. Check the transformer connections.

182 POWER SUPPLY VOLTAGE LEVEL CHECKS

AC Voltage Levels

120-Volt Power Supply

Line Voltage	Limits	From TB1-1 To
115	104 to 126 Vac	TB1-2

World Trade Power Supply (60 Hz)

Line Voltage	Limits	From TB1-1 To
100 Vac	90 to 110 Vac	TB1-3
115 Vac	104 to 126 Vac	TB1-4
200 Vac	180 to 220 Vac	TB1-5
208 Vac	188 to 228 Vac	TB1-6
220 Vac	198 to 242 Vac	TB1-7
230 Vac	207 to 253 Vac	TB1-8

World Trade Power Supply (50 Hz)

Line Voltage	Limits	From TB1-1 To
100 Vac	90 to 110 Vac	TB1-3
110 Vac	99 to 121 Vac	TB1-4
123.5 Vac	112 to 135 Vac	TB1-5
200 Vac	180 to 220 Vac	TB1-6
220 Vac	198 to 242 Vac	TB1-7
235 Vac	212 to 258 Vac	TB1-8

DC Voltage Levels

The DC voltage levels can be checked as follows on the power cable to planar 1 or at the power supply.

DANGER
Line voltage is present at the power supply.

DC Power Supply (184)	DC Voltage Levels	Planar Board Connections (103)		
		Planar 1, Connector G	Planar 2, Connector G	Planar 3, Connector D
J01-1, J01-3 through J01-10	+5 (+4.7 to +5.5)	B02, B03, D02, D03	B12, D12, D13	B02, B03, D03
J01-13, J01-14	−5 (−4.6 to −5.4)	B06	D09	B06
J01-11, J01-12	+8.5 (+7.7 to +9.4)	B10, B11	D04, D05, D06	B10, B11, B12
GT-1 through GT-5	Ground	D05, D06, D07, D09, D10	B05, B06, B07, B08, B09, B10	D05, D06, D07, D08, D09, D10

The DC power to the planar board cable is part of a cable assembly that carries the display signal lines to the planar boards.

Power Supply Terminal Block Position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
DC Voltage	+5	+5	+5	+5	+5	+5	+5	+5	+5	+8.5	+8.5	+8.5	+8.5	+8.5	−5	−5
Connector to Power Supply	J01	J03	J04	J05	J06	J07	J08	J09		J11			J12			J14
Connector to Planar 1 (G)				B03	B02	D03			D02			B10 B11			B06	
Connector to Planar 2 (G)	D12	D13	B12							D04	D05 D06				D09	
Connector to Planar 3 (D)							B03	B02	D03				B12	B10 B11		B06

183 POWER SUPPLY RIPPLE LEVEL CHECK

The peak-to-peak output ripple should be less than 4% of the respective DC voltages when measured with an oscilloscope.

When an oscilloscope is not available, ripple voltage can be observed by using the multimeter with the dB adapter as follows:

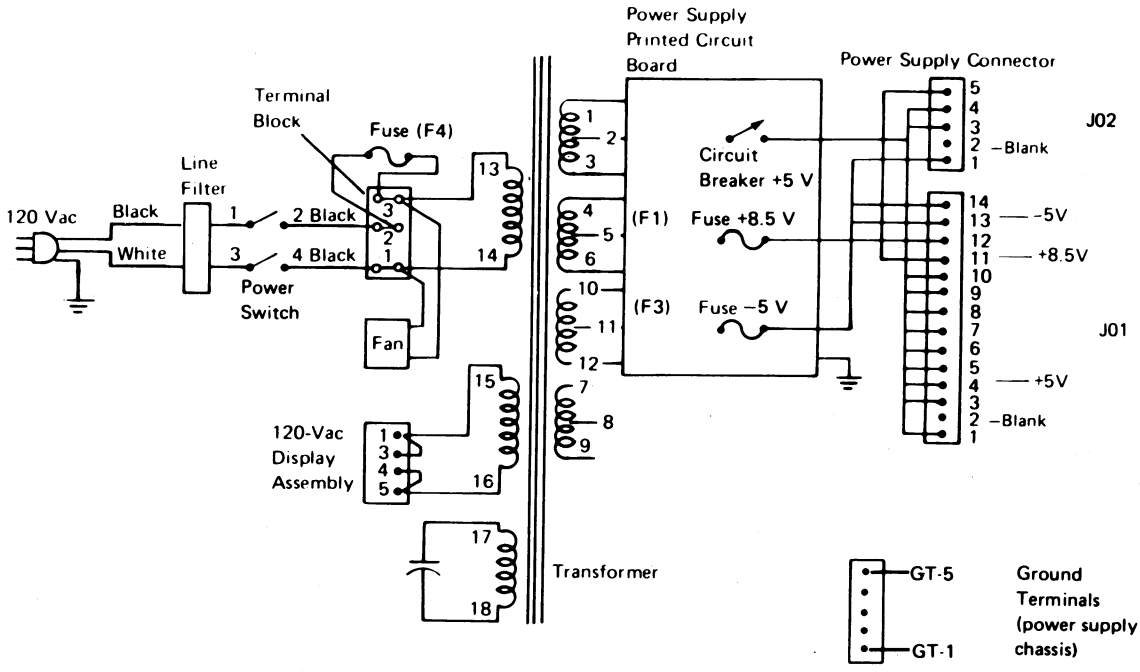
1. Set the dB adapter to Bridge mode.
2. Set the Range switch to 0 dB.
3. Connect one of the dB adapter leads to frame ground and the other lead to the DC voltage in question.
4. Change the setting on the Range switch until the meter needle is as close as possible to the medium range.
5. Use the following table to determine if you have an acceptable ripple level:

Power Supply Voltage	Acceptable Ripple Level
±5 V	−21 dB to −60 dB
±8.5 V	−17 dB to −60 dB

184 POWER SUPPLY SCHEMATICS

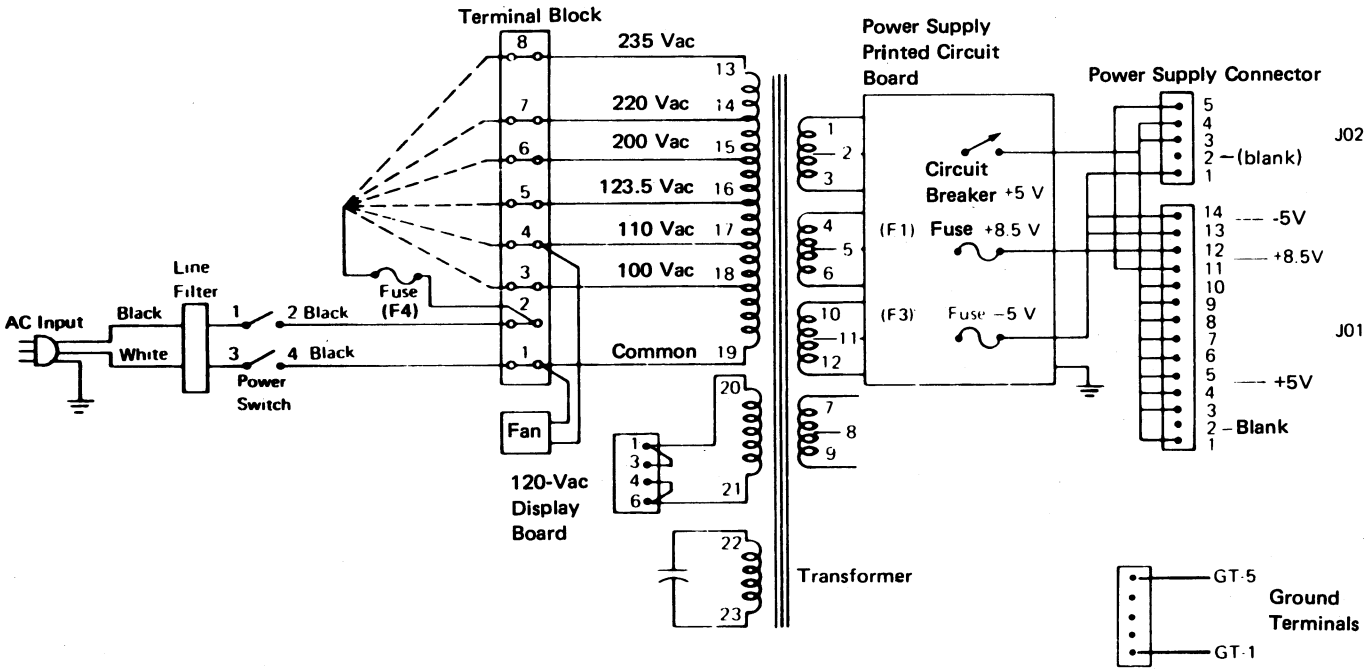
120-Volt Power Supply

Voltage	Limits	From TB1-1 To
115	104 to 126 Vac	TB1-2



184 (continued)

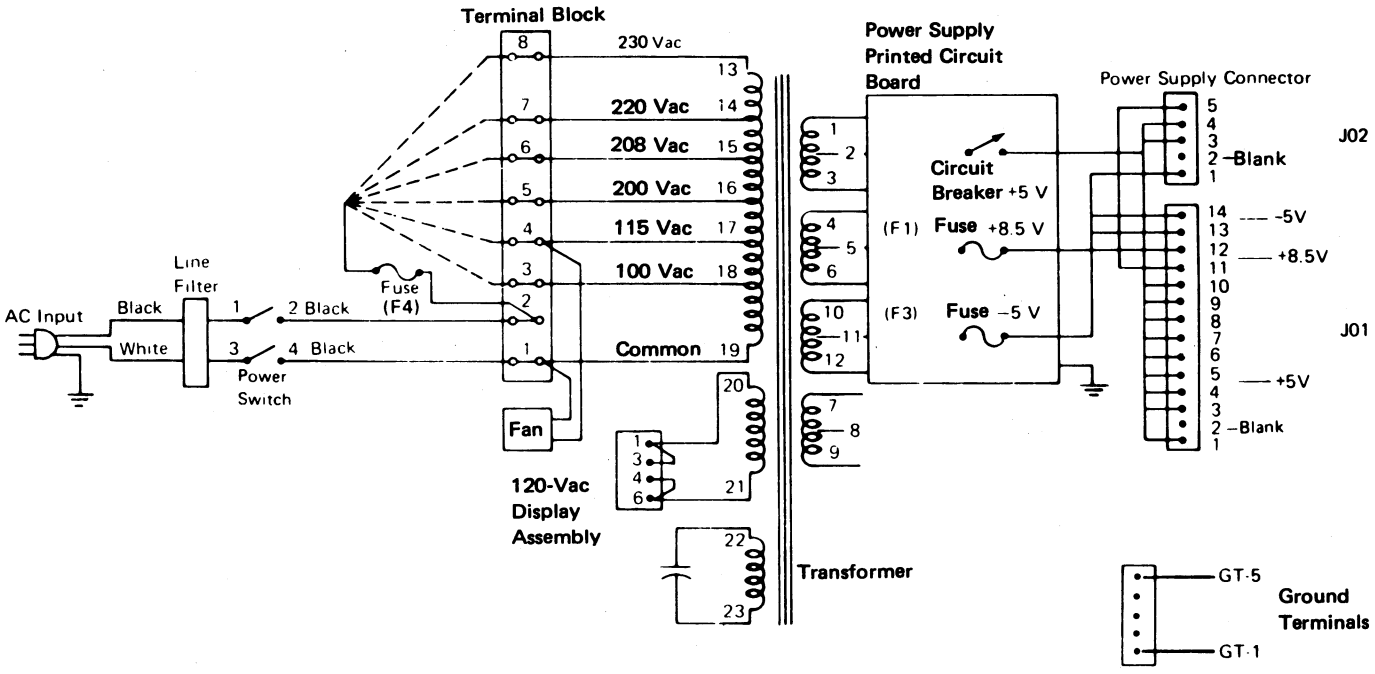
World Trade Power Supply (50 Hz)



Line Voltage	Limits	From TB1-1 To
100 Vac	90 to 110 Vac	TB1-3
110 Vac	99 to 121 Vac	TB1-4
123.5 Vac	112 to 135 Vac	TB1-5
200 Vac	180 to 220 Vac	TB1-6
220 Vac	198 to 242 Vac	TB1-7
235 Vac	212 to 258 Vac	TB1-8

Voltage	Planar Board Connection		
	Planar 1	Planar 2	Planar 3
+5 Vdc	1–G–B02 1–G–B03 1–G–D03	2–G–B12 2–G–D12 2–G–D13	3–D–B02 3–D–B03 3–D–D03
–5 Vdc	1–G–B06	2–G–D09	3–D–B06
+8.5 Vdc	1–G–B10 1–G–B11	2–G–D04 2–G–D05 2–G–D06	3–D–B10 3–D–B11 3–D–B12
Ground	1–G–D05 1–G–D06 1–G–D07 1–G–D09 1–G–D10	2–G–B05 2–G–B06 2–G–B07 2–G–B08 2–G–B09 2–G–B10	3–D–D05 3–D–D06 3–D–D07 3–D–D08 3–D–D09 3–D–D10

World Trade Power Supply (60 Hz)

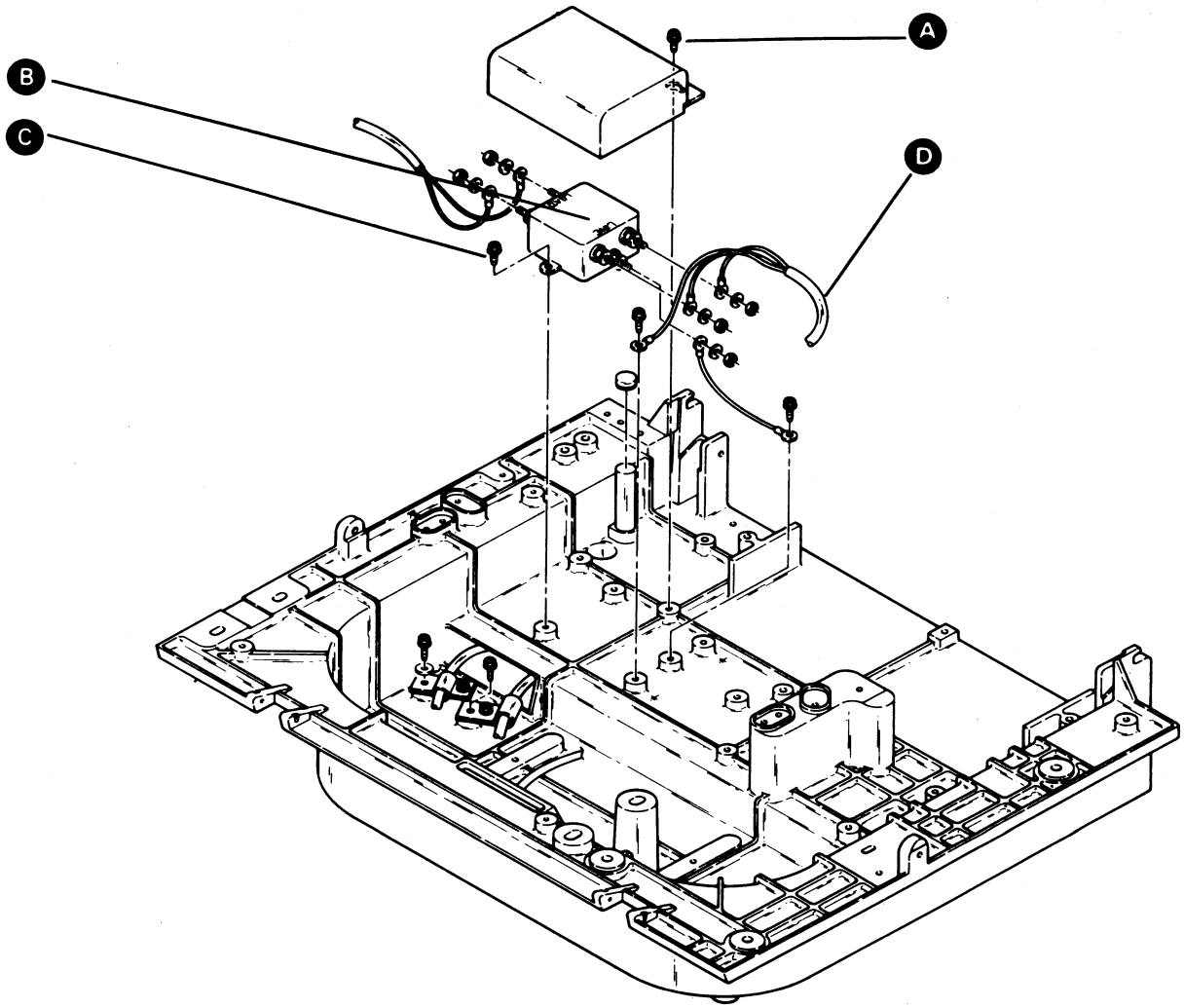


Line Voltage	Limits	From TB1-1 To
100 Vac	90 to 110 Vac	TB1-3
115 Vac	104 to 126 Vac	TB1-4
200 Vac	180 to 220 Vac	TB1-5
208 Vac	188 to 228 Vac	TB1-6
220 Vac	198 to 242 Vac	TB1-7
230 Vac	207 to 253 Vac	TB1-8

Voltage	Planar Board Connection		
	Planar 1	Planar 2	Planar 3
+5 Vdc	1–G–B02 1–G–B03 1–G–D03	2–G–B12 2–G–D12 2–G–D13	3–D–B02 3–D–B03 3–D–D03
–5 Vdc	1–G–B06	2–G–D09	3–D–B06
+8.5 Vdc	1–G–B10 1–G–B11	2–G–D04 2–G–D05 2–G–D06	3–D–B10 3–D–B11 3–D–B12
Ground	1–G–D05 1–G–D06 1–G–D07 1–G–D09 1–G–D10	2–G–B05 2–G–B06 2–G–B07 2–G–B08 2–G–B09 2–G–B10	3–D–D05 3–D–D06 3–D–D07 3–D–D08 3–D–D09 3–D–D10

185 LINE CORD AND LINE FILTER REMOVAL AND REPLACEMENT

1. Power off.
2. Unplug the line cord (D) from the wall outlet.
3. Open the front and rear covers.
4. If the line filter screws (C) are not accessible, remove the display assembly (151).
5. Loosen the two screws (A) on the line filter cover.
6. If the line filter (B) is to be replaced, remove the two line filter mounting screws and disconnect the cables as required.
7. Install the new line cord/line filter using this procedure in reverse order. Be sure to connect the ground wires and replace the line filter cover.



186 NOT USED

187 POWER SUPPLY FAN REMOVAL AND REPLACEMENT

Removal

1. Power off.
2. Disconnect the line cord from the outlet.
3. Open the front and rear covers.
4. If a fan guard is present, remove the nuts holding the fan guard to the power supply frame.
5. Remove the remaining nuts holding the fan assembly to the power supply frame.
6. Remove the two wires that connect the fan to the power supply.
7. Lift up the heat sink assembly and the fan assembly.
8. Remove the four screws and four nuts that hold the fan assembly to the heat sink assembly.

Replacement

CAUTION
Do not crimp or pinch the two voltage wires between the fan and the power supply frame.

To replace the fan assembly, reverse the preceding steps.

188 POWER ISOLATION MINI-MAP

- Use this mini-MAP to isolate power/planar problems in the display station.

Conditions After Power On

Service Aids

Power off when disconnecting cables or checking fuses. (See section 184 for power locations.)

DANGER
If you are not careful, you could receive an electrical shock while performing the next procedures.

_____
_____

Is the fan running?
Y N

Is the line cord plugged in?
Y N

– Plug in the line cord.

– Power off.
– Check the ac power supply fuse.
Is the ac power supply fuse OK?
Y N

– Replace fuse with proper size and rating.
– If the fuse blows again, replace power supply (181).

– Measure the ac voltage at the top terminals (transformer side) of the power switch.
– Power on.

Is the voltage inside the limits?
Y N

– Measure ac voltage at the line filter side of the power switch (184).

Is the voltage inside the limits?
Y N

– Measure the voltage at the customer power outlet.

A

A

Is the voltage inside the limits?
Y N

– Inform customer of power outlet problem.

– Repair or replace line cord/line filter (185).

– Disconnect the line cord from the power outlet.
– Replace power switch (110, 184).

– Replace the fan (187).

DC Distribution Check

Is the low voltage circuit breaker on? (180)
Y N

– Set the CB.
– If the CB trips, do the following; disconnect:
  1. Ac power connector to display.
  2. Low voltage cable at power supply.
– Set the CB

Does the CB trip again?
Y N

– Power off when removing or plugging cables.
– Disconnect all cables at planar.
– Connect low voltage cable at power supply.
– Plug one cable at a time until cable on unit causes CB to trip.

– Replace power supply (181).

– Check dc voltages at power supply test points and check dc voltages at connector G of planar 1:

+5Vdc	4.6 to 5.5	1–G–D03, B03, B02
–5Vdc	–4.6 to –5.5	1–G–B06
+8.5 Vdc	7.7 to 9.4	1–G–B10, B11

Are the voltages inside limits?
Y N

– Check fuse 1 and fuse 3 (180).
– Repair/replace power cable.
– Replace power supply (181).

– Refer to section 111, *use Circuit B, Ready light.*

Diagnostic Aids

200 CONTROL PANEL AND PLANAR LEDs

The following five lights (LEDs) are located on the control panel of the display station: Line Sync, Line Check, Internal Check, Storage Check, and Ready. These lights are used by the operator and the customer engineer. All five lights are on briefly during power on to test the LEDs. After power on, use the following descriptions.

Line Sync

When on, this light indicates that the display station has recognized a poll or data that the controller sent over the system cable. The poll or data can be for any display station on the cable (Cable Thru feature). The light goes off if there is more than 160 ms between recognized characters.

Line Check

When on, this light indicates that the display station has sensed a parity error in the poll or data that the controller sent. When the Cable Thru feature is installed, each display station turns this light on even if the poll or data is not addressed to that particular work station. The addressed work station returns an error response to the controller. The controller resends the information that caused the error until the display station receives the information without any errors; at this time, the light turns off.

Internal Check

When on, this light indicates that a parity error has been found in the data bus while the display station is getting data from read/write storage. You can reset the Internal Check light by setting the Status switch to the Test position. A power on reset occurs when this light is being reset by the Status switch.

Storage Check

When on, this light indicates that a parity error has been found while reading a byte of data from extended character storage. (The extended character storage is located on the Planar 2 board or, with the Extended Display Character Expansion feature, on the storage extension card.

Ready

When on, this light indicates that the power-on diagnostic has completed correctly. The Ready light is off if the Status switch is in the Test position, if either or both the Storage Check and Internal Check lights are on, or if the microprocessor is in a diagnostic sequence. The MPU controls this light.

Planar Storage Check

A storage check light (LED) is located on planar 2 and on planar 3 (when the Extended Display Character Expansion feature is installed). When on, this light indicates that a parity error has been found while reading a byte of data from the extended character storage located on that planar. If the stop-on-storage-clock jumper is installed, the microprocessor stops if there is a parity error. The jumper should be installed during failure diagnosis only (105).

201 STATUS SWITCH

The Status switch on the control panel is a diagnostic aid for the customer engineer. It also functions as a reset switch and as a problem determination aid for the operator.

If the switch is in the *Test* position when the display station is powered on, the power-on diagnostic displays the scan code for each key pressed. The power-on diagnostic continues to loop with the cursor in position B until the switch is set to the *Normal* position.

The settings of the address switches (Cable Thru feature only) should not be changed while the power-on diagnostic is looping unless a keyboard data key is pressed and held down. Release the key to permit the power-on diagnostic to loop after the settings of the address switches have been changed so that the changes can be seen in the address field of the display screen.

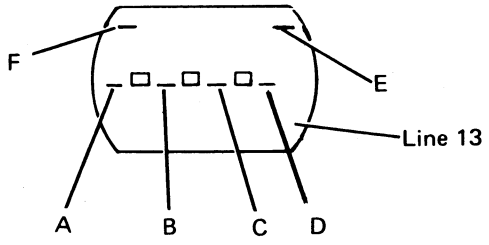
If the cursor is in position E and the Status switch is in the *Normal* position, the clicker sounds only for the first four keys pressed. Additional keys can be pressed, but the clicker does not sound. If the Status switch is now set to the *Test* position, line 13 is displayed for approximately 5 seconds. During this 5 seconds, the hexadecimal code of the last key pressed is displayed in position 76 of line 13.

Line 13 is displayed when the Status switch is set to the *Test* position while a customer job is being run or when the cursor is in position F. Display station operation is not affected. Line 13 is removed when the Status switch is set to the *Normal* position.

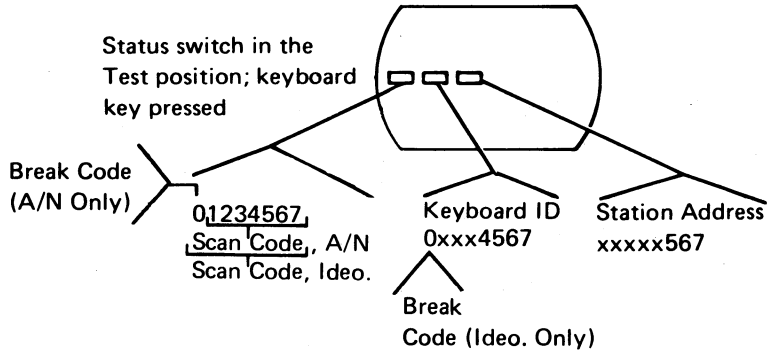
You can reset the Storage Check light and Internal Check light by setting the Status switch to the *Test* position. The operator must sign on and restart the customer job after the Status switch has been set to the *Normal* position.

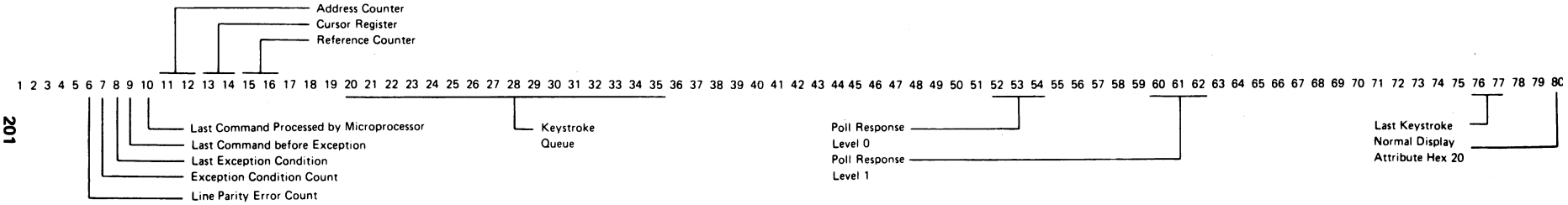
The field attribute is displayed when the Status switch is in the *Test* position.

Cursor Display Positions



Power-On Diagnostic Display





Line Position	DESCRIPTION
1-3	Time Slice Register Save Area
4	Audible Alarm Clicker Count
5	System Available Sample Count
6	Line Parity Error Count
7	Exception Condition Count
8	Last Exception Condition
9	Last Command Before Exception
10	Last Command Processed by Microprocessor
11	Address Counter Hi
12	Address Counter Lo
13	Cursor Register Hi
14	Cursor Register Lo
15	Reference Counter Hi
16	Reference Counter Lo
17	Keystroke Queue Read Pointer
18	Keystroke Queue Full Flag
19	Keystroke Queue Write Pointer
20-35	Keyboard Keystroke Queue
36-51	Cable Adapter Command Queue
52-54	Poll Response Level 0
55	Poll Response Delimiter
56-59	(Not Used)
60-62	Poll Response Level 1
63	Poll Response Delimiter
64-67	(Not Used)
68	Cable Adapter Control Register Hi
69	Cable Adapter Control Register Lo
70	Cable Adapter Address Register Hi
71	Cable Adapter Address Register Lo
72	Cable Adapter Length Register Hi
73	Cable Adapter Length Register Lo
74	Cable Adapter Sense Register
75	Last Cable Adapter Sense Reg. Value
76	Key Code of Last Key Pressed
77	I/D & M/B Byte of Last Key Pressed
78-79	User Accessible Address Limit
80	Normal Display Attribute Hex 20

ALTERNATIVE DISPLAY

Line Position	DESCRIPTION
1-16	(Not Used)
17-32	I/O Device Data Storage Area
33	Keylock Feature Status Hex 00 if Off or Not Installed
34-35	(Not Used)
36-39	Subroutine Save Area
40	(Not Used)
41	Time Slice Return Address Hi
42	Time Slice Return Address Lo
43-45	Time Slice Register Save Area
46	Same as Position 1 of Main Display

LINE 13 INFORMATION

The table indicates all the information displayed on line 13 when the status switch is set to the test position; the illustration shows only the most commonly used information.

For the A/N keyboard, an alternative display of line 13 occurs whenever contents of the last key log contain the break bit. This is the result of pressing and releasing any shift key before or during the time the status switch is set to the test position.

For the ideographic keyboard, an alternative display of line 13 occurs whenever contents of the last key log contains a make bit. This is the result of holding down any key before or during the time the status switch is set to the test position.

202 FIELD ATTRIBUTE CHARACTERS

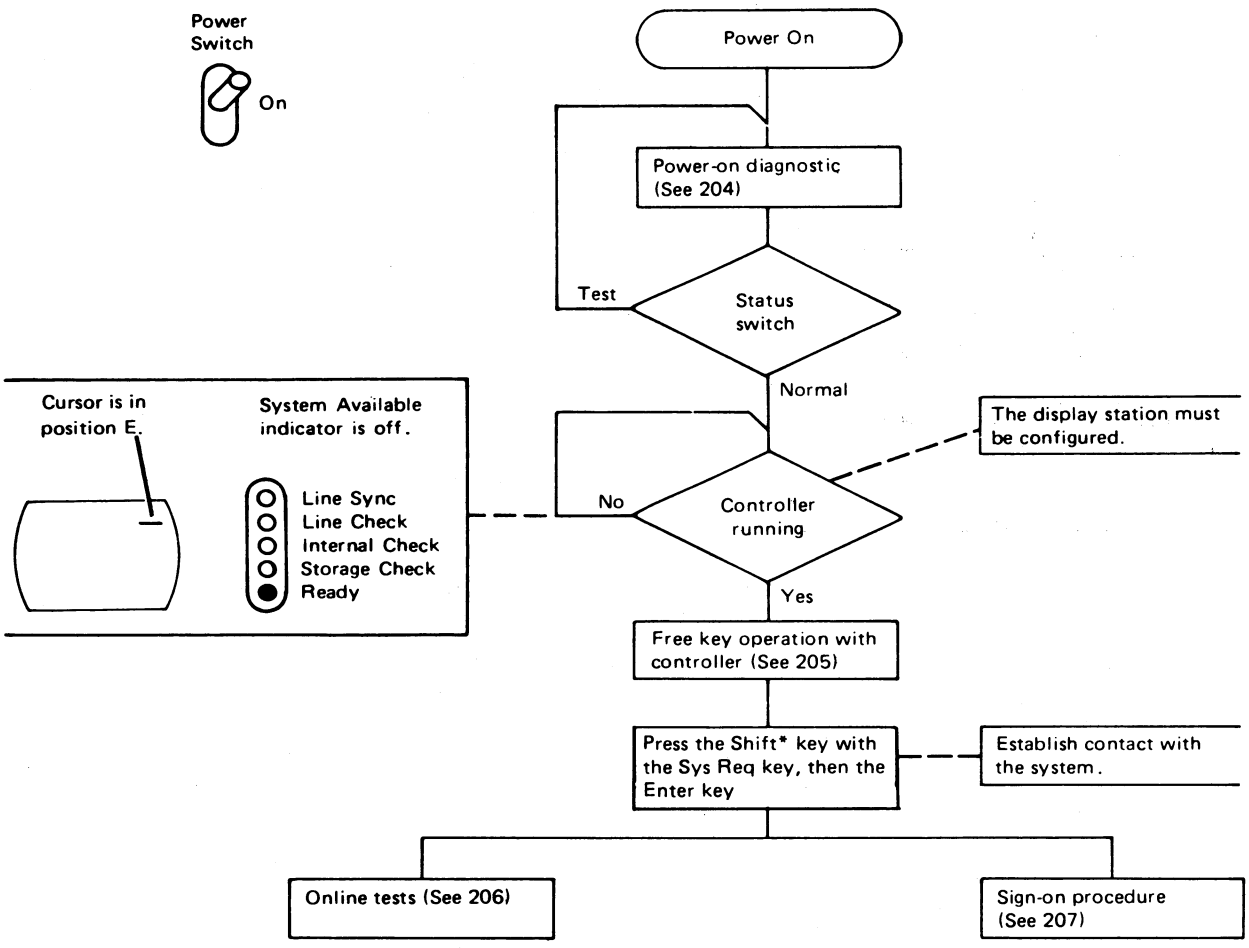
You can display field attribute characters by setting the Status switch to the Test position. The hexadecimal code is displayed to the left of the field that it converts. A description of each code follows:

Hex Code	Description
20	Normal display
21	Reverse image
22	High intensity
23	Reverse image, high intensity
24	Underscore
25	Underscore, reverse image
26	Underscore, high intensity
27	No display
28	Blink
29	Blink, reverse image
2A	Blink, high intensity
2B	Blink, high intensity, reverse image
2C	Blink, underscore
2D	Blink, underscore, reverse image
2E	Blink, underscore, high intensity
2F	No display

Hexadecimal codes 30 through 3F are the same as 20 through 2F; however, codes 30 through 3F contain column separators between each character in the field.

203 DISPLAY STATION OPERATION OVERVIEW

The following flowchart shows the sequence of operations from power on to either customer sign-on or verification test.

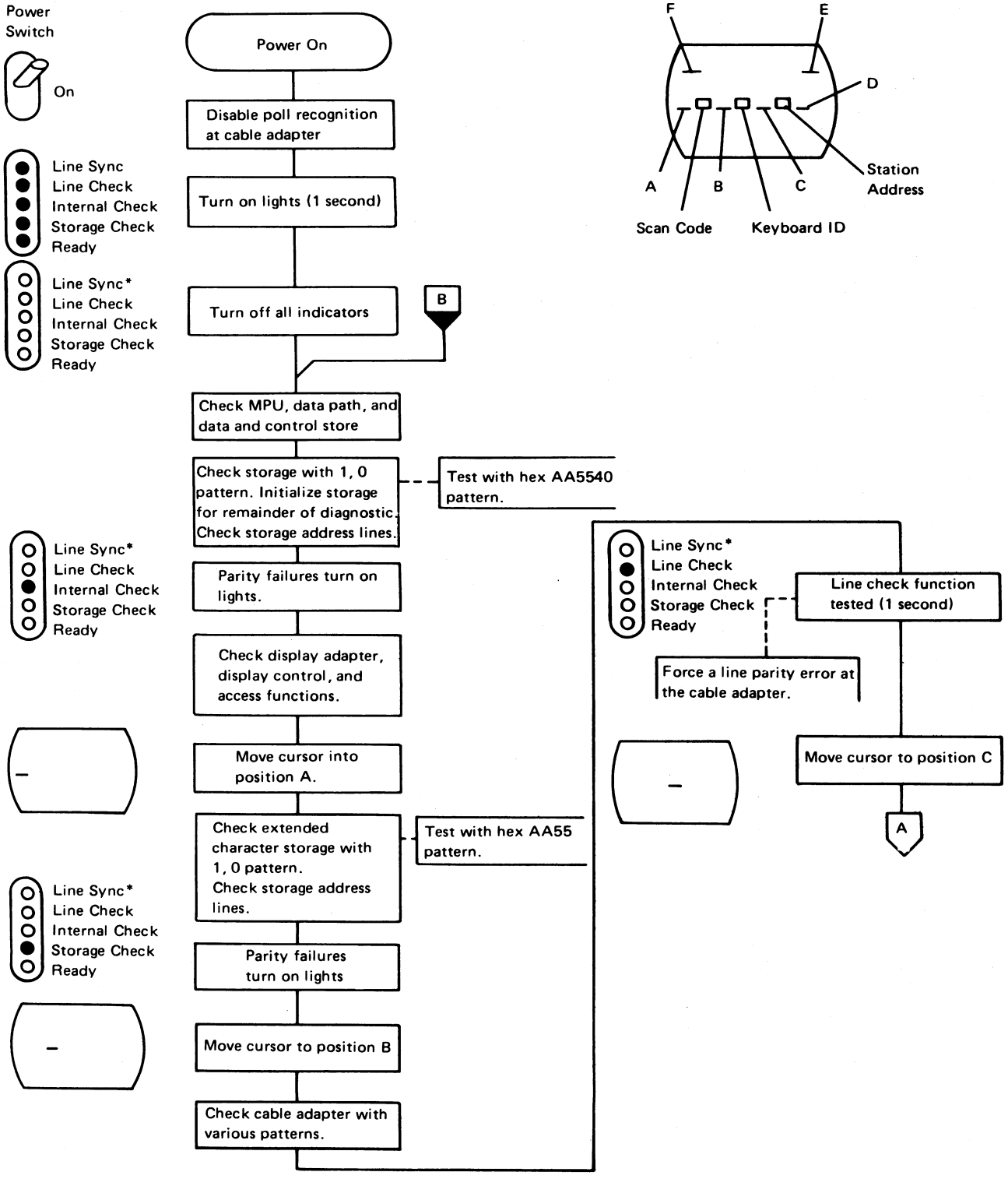


*On the ideographic keyboard, press the ALT SHIFT key.

204 POWER-ON DIAGNOSTIC

The following flowchart shows the steps performed by the internal diagnostics when the display station is powered on.

Power-On Diagnostic Flowchart (Part 1 of 3)

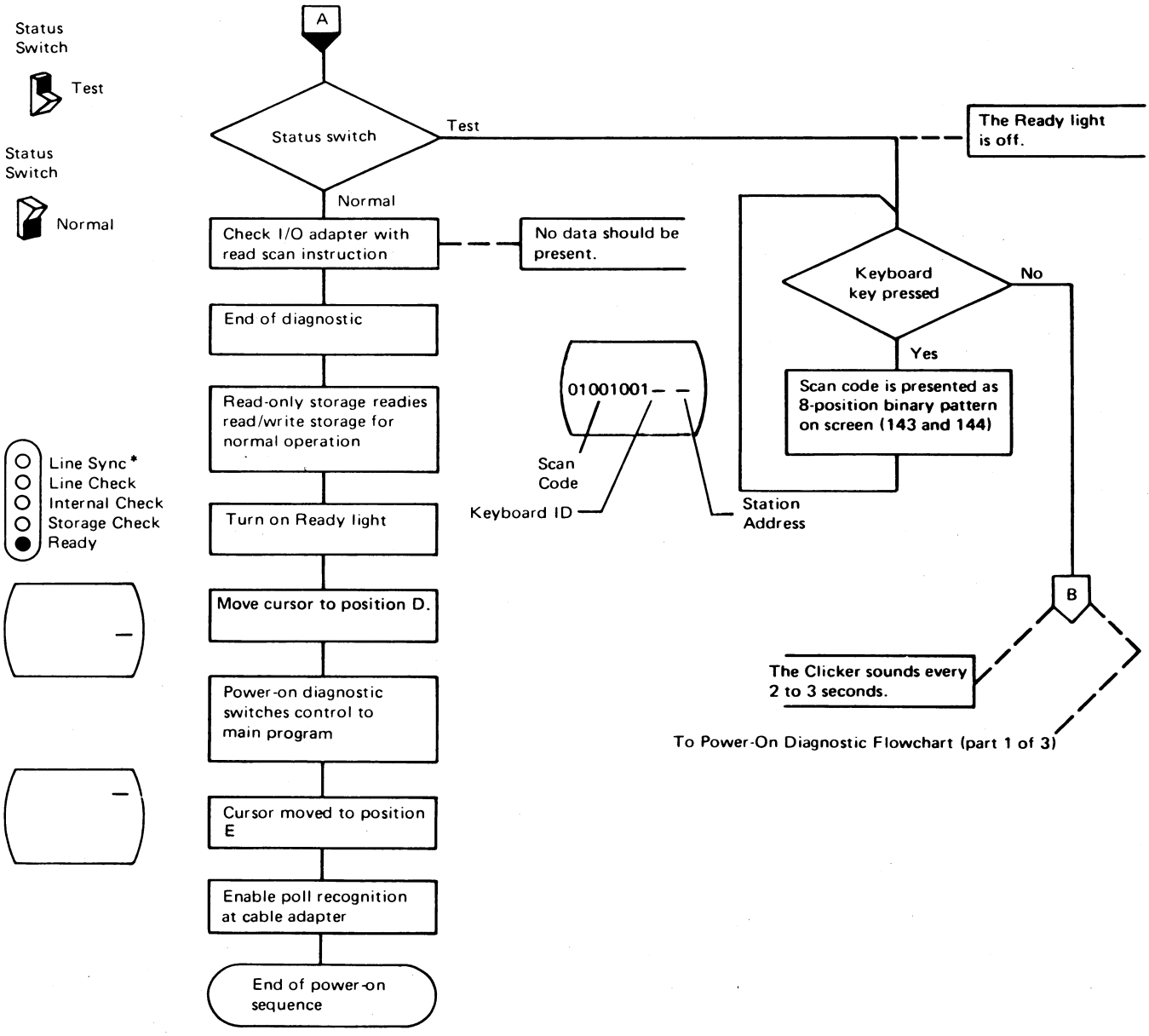


*The Line Sync light is on while the controller is polling.

At the end of this diagnostic, you can perform more tests using the free key mode or the verification test, or you can sign on using the sign-on procedure.

Cursor Positions

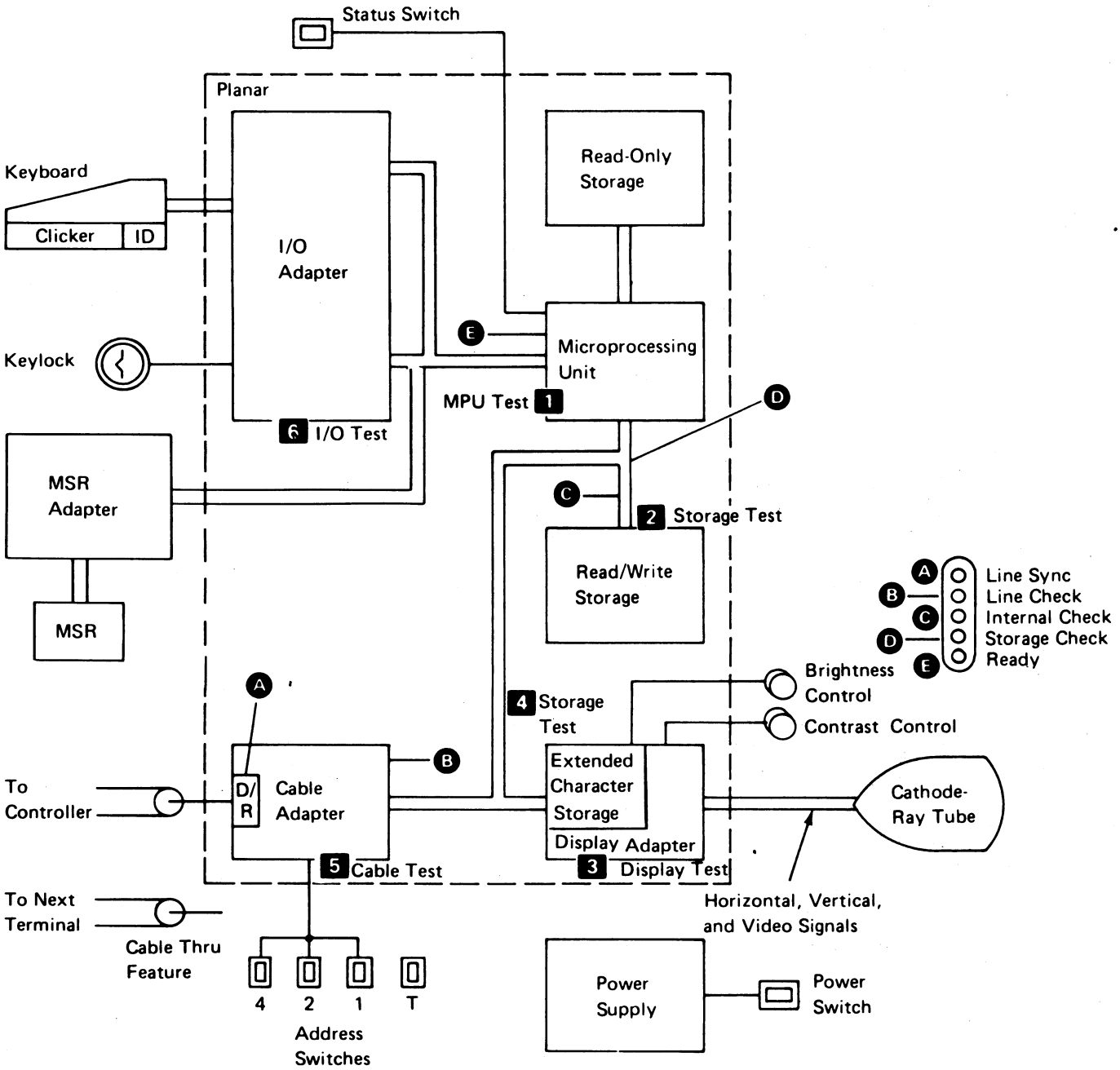
Power-On Diagnostic Flowchart (Part 2 of 3)



* The Line Sync light is on while the controller is polling.

Power-On Diagnostic Flowchart (Part 3 of 3)

The numbers indicate the sequence in which the power-on diagnostic checks the major areas of the adapters.



204 (continued)

Diagnostic Test Routine

- Power off.
- Switch to test.
- Power on.

Do the diagnostics loop?
Y N

- Use section 188.

Various patterns show on the display. The Line Check light changes from on to off to on.

- Press the G key on keyboard .

Are the scan code, keyboard ID, station address fields displayed correctly (210)?
Y N

- Replace planar 1 (103, 105)

- Check if station is configured in system.
- If OK, use LOGOUT.

205 FREE-KEY OPERATION

The display station is in the free-key mode after the power-on diagnostic has been completed and before the customer signs on. While in the free-key mode, the display station communicates with the controller and permits keyed characters to be displayed; because keyed characters are displayed you can check the alphanumeric keys and many of the function keys.

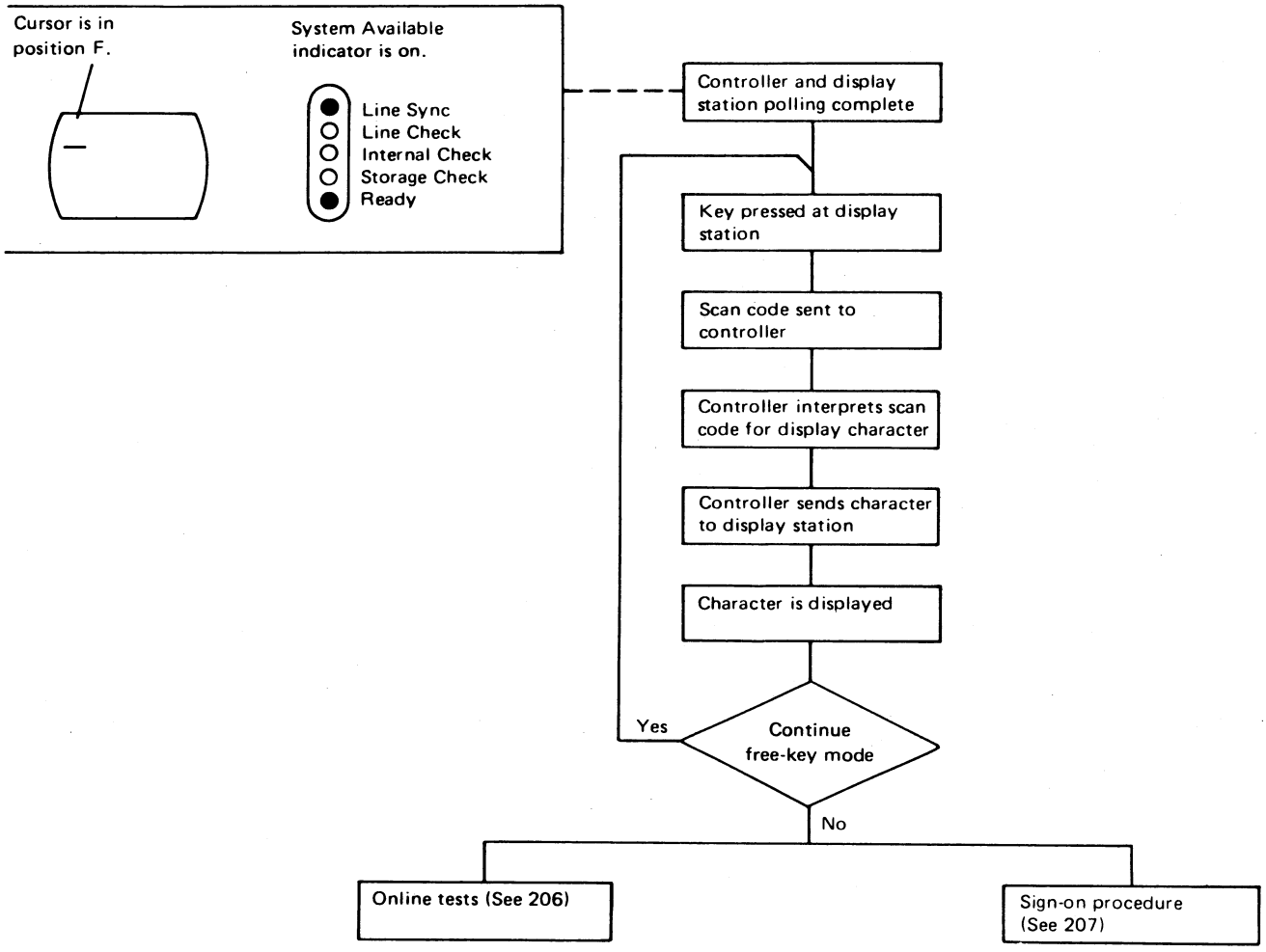
If the following function keys are pressed while the display station is in the free-key mode, error code 0099 will be returned:

PRINT	Enter/Record Advance
HELP	Test Request (command function)
ROLL ↑ (Up)	Attention
ROLL ↓ (Down)	Command function
HOME (in home position)	keys 1 through 24

In free-key mode, the entire screen is defined as an "either" field initialized to alphanumeric mode. When in the first input position of an *either* field, the cursor blinks. With the ideographic keyboard, free-key operation is the same as for the alphanumeric keyboard except that you must press the CMD key followed by the ALT/IDEO key to enter two-byte characters. For more information about free-key operation and field types, refer to the *IBM 5255 Display Station, Operator's Guide,* GA09-1626.

Use the online tests (206) to check these key operations.

Free-Key Mode Flowchart

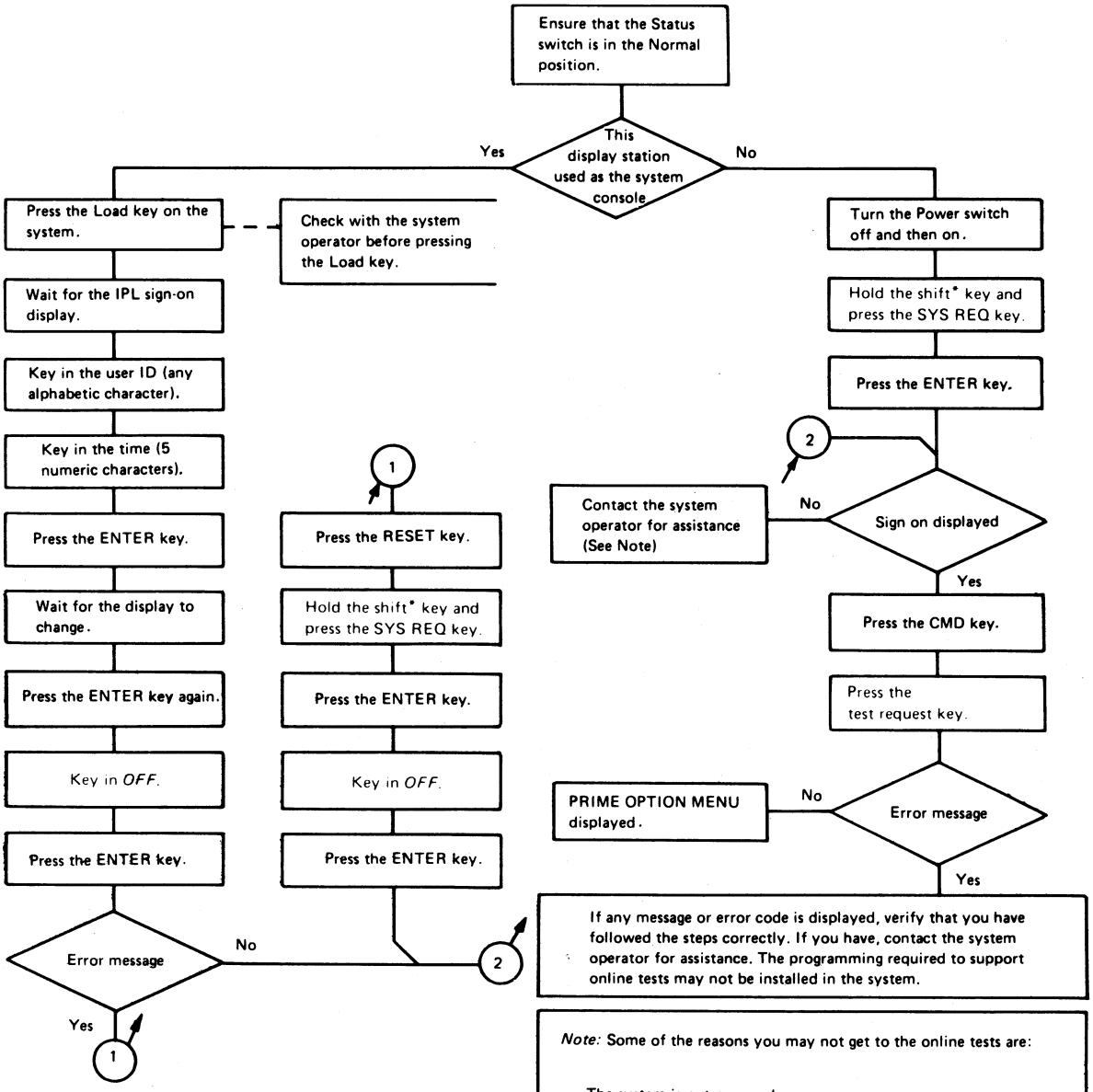


206 ONLINE TESTS

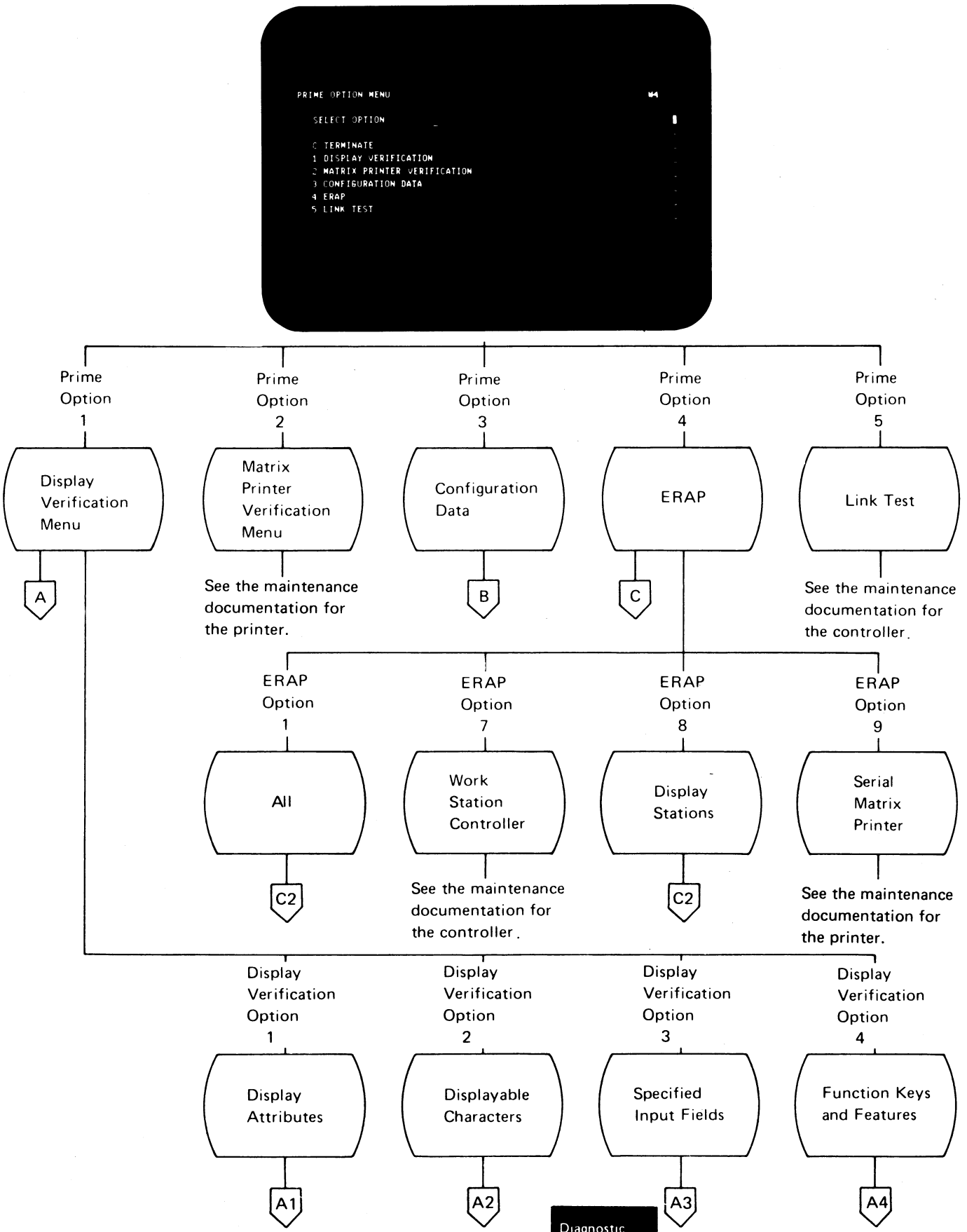
Online tests include work station exerciser routines that are contained in the system. The PRIME OPTION MENU is displayed; this menu permits the selection of the following: display verification, matrix printer verification, configuration data, and ERAP (error recording analysis procedures), and link test (this test is used by the controller only).

The DISPLAY VERIFICATION MENU permits the selection of the following tests: the display attributes test, the displayable characters test, the specified input fields test, the function keys and features test, and the link test. The display attributes test and the displayable characters test check the planar. The specified input fields test checks the controller. The function keys and features test checks the system and the features installed on the display station. The link test is used by the controller only and is described in the controller documentation.

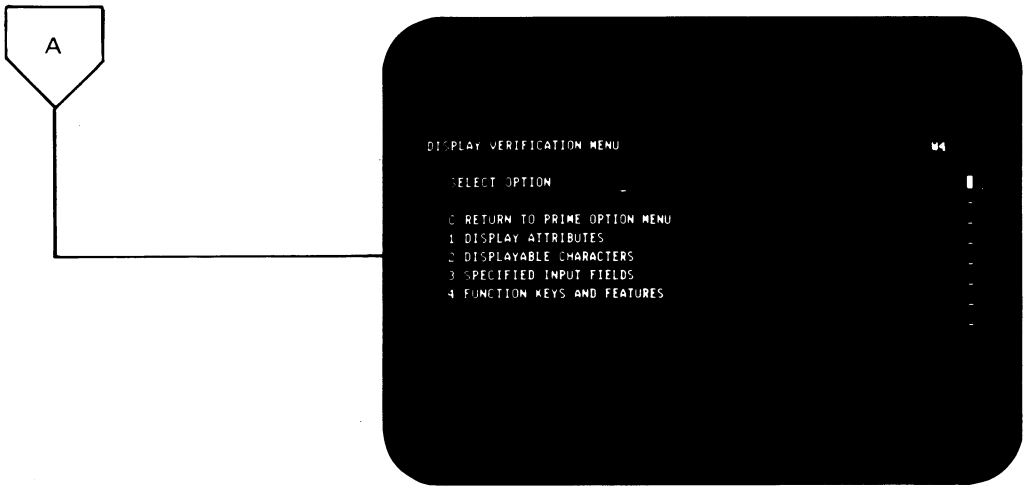
Online tests can be run on the work station while other jobs are being run on the system. However, the work station must be in a signed-off condition before online tests can be run on that work station. There may be various methods that can be used to terminate or sign off a job. These methods are not described in this manual because they are system operating procedures. If you do not know the procedure to use with the system, use the procedure in the following flowchart.



*On the ideographic keyboard, press the ALT SHIFT key.


PRIME OPTION MENU
SELECT OPTION
0 TERMINATE
1 DISPLAY VERIFICATION
2 MATRIX PRINTER VERIFICATION
3 CONFIGURATION DATA
4 ERAP
5 LINK TEST
Prime Option 1
Display Verification Menu
A
Prime Option 2
Matrix Printer Verification Menu
See the maintenance documentation for the printer.
Prime Option 3
Configuration Data
B
Prime Option 4
ERAP
C
Prime Option 5
Link Test
See the maintenance documentation for the controller.
ERAP Option 1
All
C2
ERAP Option 7
Work Station Controller
See the maintenance documentation for the controller.
ERAP Option 8
Display Stations
C2
ERAP Option 9
Serial Matrix Printer
See the maintenance documentation for the printer.
Display Verification Option 1
Display Attributes
A1
Display Verification Option 2
Displayable Characters
A2
Display Verification Option 3
Specified Input Fields
A3
Display Verification Option 4
Function Keys and Features
A4

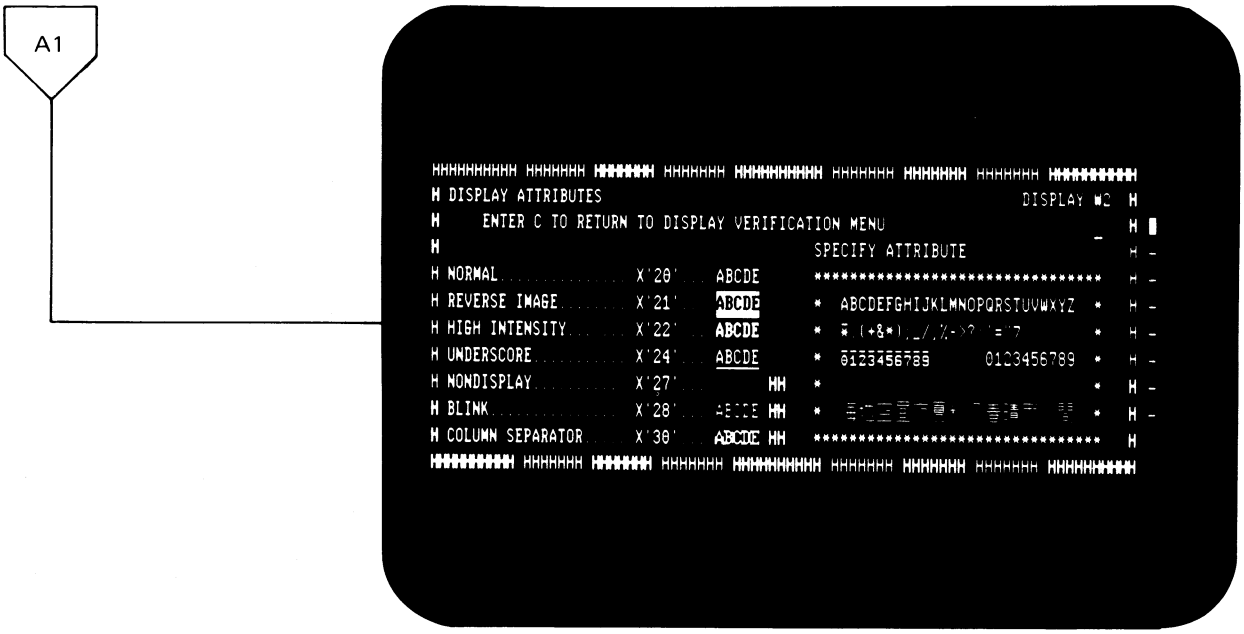
Online Tests Displays



Station ID (W2, P1, etc) can be as many as 10 characters.

Select the DISPLAY VERIFICATION MENU by:

a. Pressing the 1 key.
b. Pressing the ENTER key.



Station ID (W2, P1 etc) can be as many as 10 characters.

Select the DISPLAY ATTRIBUTES option by:

1. Pressing the 1 key.
2. Pressing the ENTER key.

This display tests the attributes, the Contrast control, and the alignment of characters on the display screen.

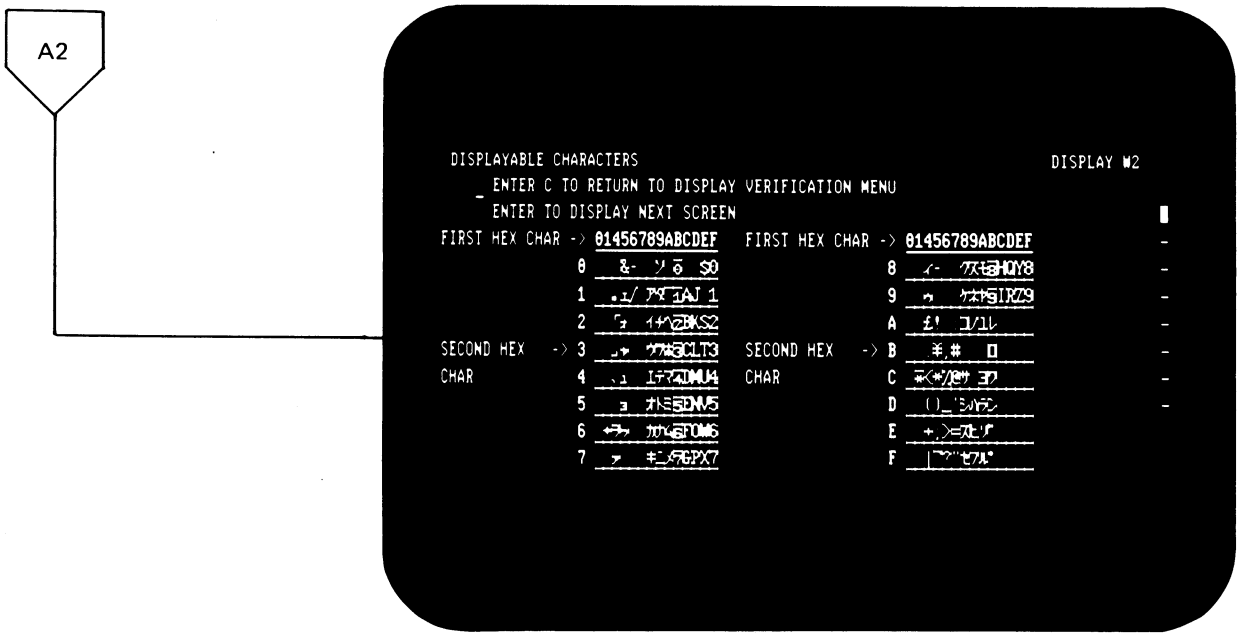
How to use this display:

1. Turn the Contrast control fully clockwise and slowly decrease the Brightness control; observe the pattern of Hs that alternate in intensity.
2. Adjust the Brightness control to obtain the best character image.
3. Press the Spacebar once to position the cursor on the right side of the display screen.
4. Key in one of the hexadecimal numbers shown on the left side of the display screen; press the ENTER key. Observe the results that take place on the right side of the display screen. Compare these results with the attribute description on the left. A wrong entry causes the entry to blink at high intensity. Repeat steps 3 and 4 for each of the remaining hexadecimal numbers.

Note: Attribute combinations are not shown on this display screen. Refer to 202, "Attribute Characters" for these combinations.

Return to the DISPLAY VERIFICATION MENU by:

1. Pressing the C key.
2. Pressing the ENTER key.



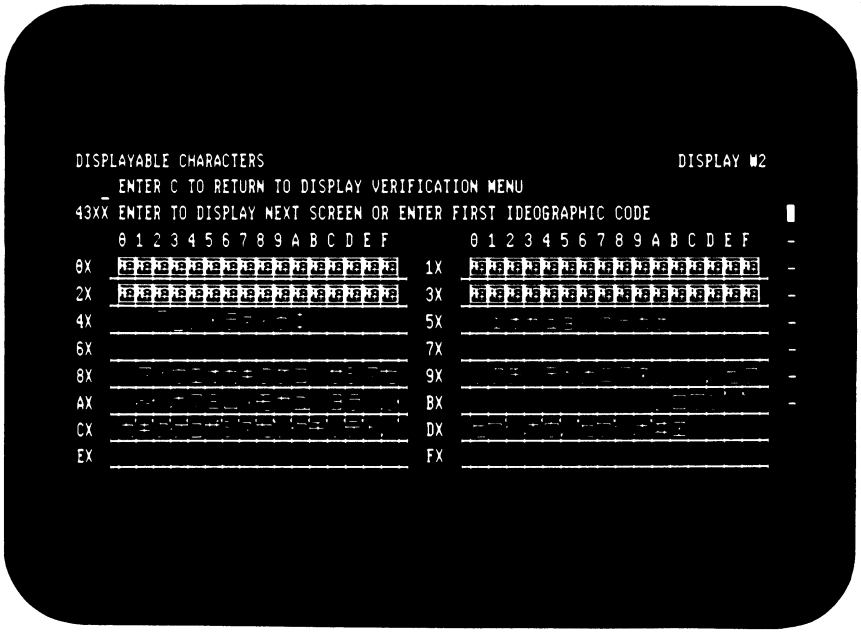
Station ID (W2, P1, etc.) can be as many as 10 characters.

Select the DISPLAYABLE CHARACTERS option by:

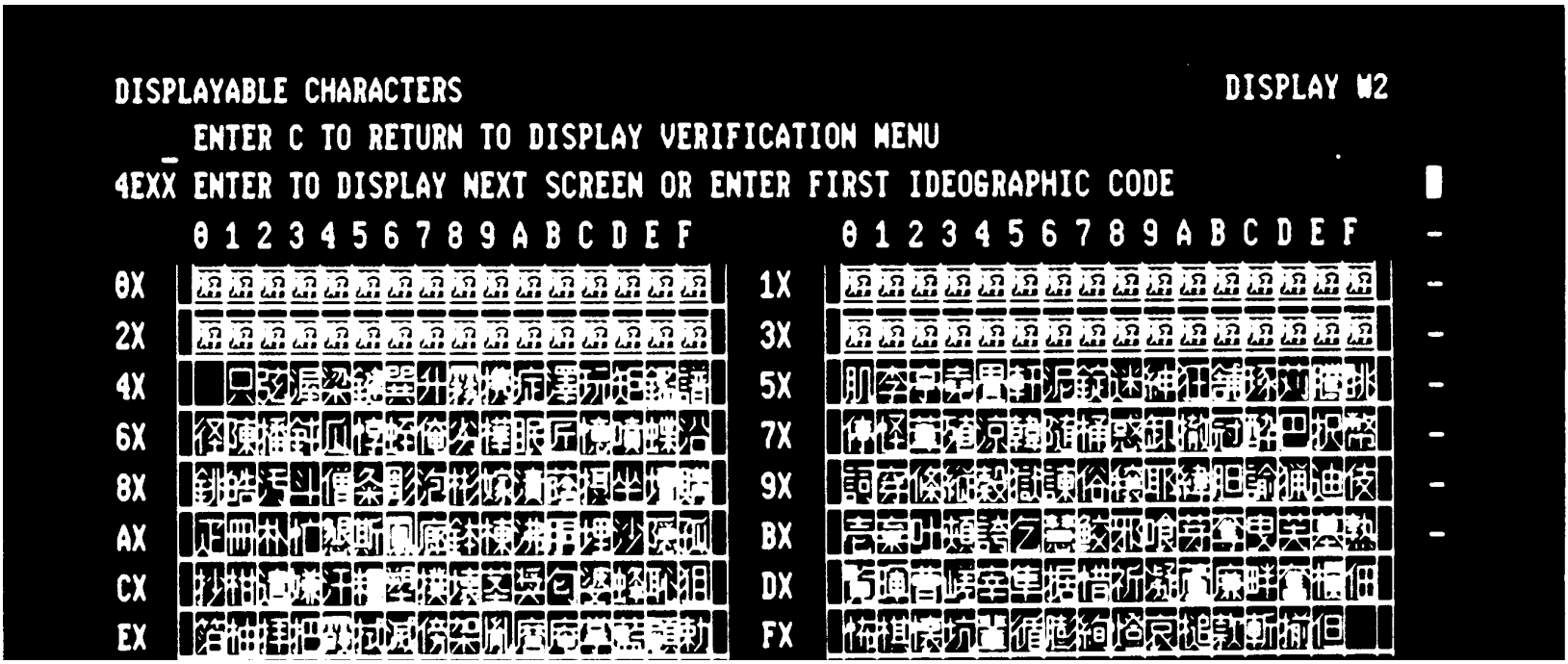
1. Pressing the 2 key.
2. Pressing the ENTER/REC ADV key.

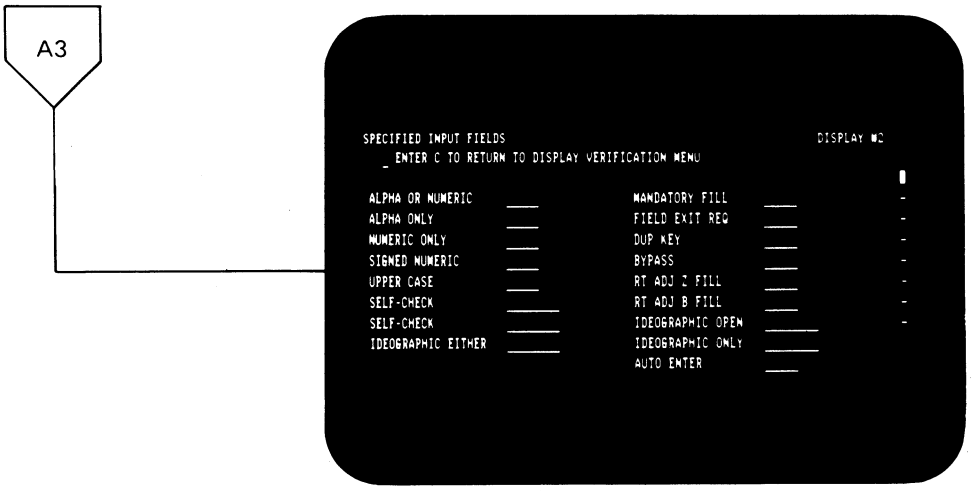
This display shows the characters that are represented by the alphanumeric (1-byte) characters on the keyboard.

To display ideographic (2-byte) characters, press the ENTER/REC ADV key once.



To display additional 2-byte characters, press the ENTER/REC ADV key once for each new screen.


DISPLAYABLE CHARACTERS
DISPLAY M2
ENTER C TO RETURN TO DISPLAY VERIFICATION MENU
4EXX ENTER TO DISPLAY NEXT SCREEN OR ENTER FIRST IDEOGRAPHIC CODE
0 1 2 3 4 5 6 7 8 9 A B C D E F
0X
1X
2X
3X
4X
5X
6X
7X
8X
9X
AX
BX
CX
DX
EX
FX



Select the SPECIFIED INPUT FIELDS option by:

1. Pressing the 3 key.

2. Pressing the ENTER key.

This display tests the controller operations that are used by the display station. Fields of information are entered, read by the controller, and written back to the display screen next to the input field.

How to use this display:

1. Press the spacebar once to place the cursor at the start of the first input field. The cursor moves from the field on the left to the field on the right when the input field information is entered.

2. Enter information in the fields described on the display screen. If an error is made, press the ERROR RESET key and correct the error.

The field descriptions are:

Alpha or Numeric: Key in five alphabetic or numeric characters.

Mandatory Fill: This field must be filled with five alphabetic or numeric characters.

Alpha Only: Key in five alphabetic characters.

Field Exit Req: Key in five alphabetic or numeric characters and then press the FIELD EXIT key.

Numeric Only: Key in five numeric characters.

Dup Key: Press the DUP key once. The key code of the DUP key will be shown until the screen is written to by the controller. This field will duplicate the Numeric Only field.

Signed Numeric: Key in four numeric characters. The cursor will remain under the last character keyed. Press the FIELD EXIT key (positive) or the FIELD-key (negative).

Bypass: This field will be automatically bypassed, and no entry will be required.

Upper Case: Key in five alphabetic characters.

Rt Adj Z Fill: Key in one alphabetic or numeric character. Press the FIELD EXIT key. The character keyed will be moved to the right of the field, and the left four positions will be filled with zeros.

Self-Check: Key in the example for Modulus 10 as shown in *Appendix C.* Include the self-check digit.

Rt Adj B Fill: Key in one alphabetic or numeric character. Press the Field Exit key. The character keyed will be moved to the right of the field, and the left four positions will be filled with blanks.

Self-Check: Key in the example for Modulus 11 as shown in *Appendix C.* Include the self-check digit.

Ideographic Open: Key in two alphanumeric characters, press the CMD key, press the ideographic mode key, and key in two ideographic shift-data combinations. When you enter the second ideographic character, the cursor should go to the next field and blink. The insert mode indicator should disappear.

Ideographic Either: Press the CMD key, then press ideographic mode key once and key in four ideographic shift-data key combinations, or press the CMD key, then the A/N mode key once followed by eight alphanumeric characters.

Ideographic Only: Key in four ideographic shift-data key combinations.

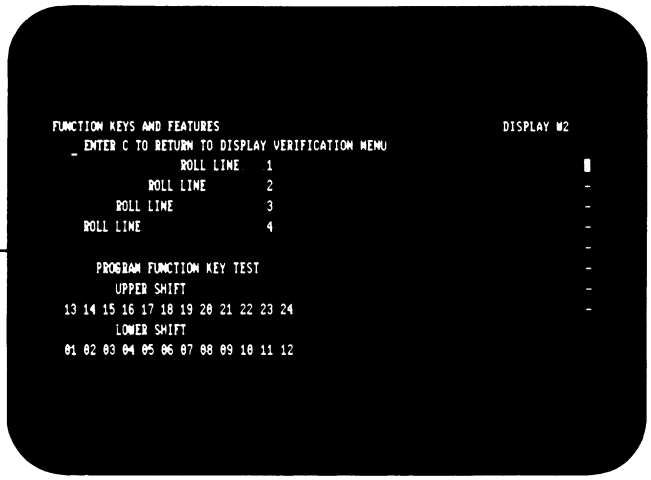
Auto Enter: Key in five alphabetic or numeric characters. As soon as the last character has been keyed, the controller reads all the input fields, sends the information to the system, and writes it back to the display screen next to the input fields.

Return to the DISPLAY VERIFICATION MENU by:

1. Pressing the C key.

2. Pressing the ENTER/REC ADV key.

A4



Select the FUNCTION KEYS AND FEATURES option by:

1. Pressing the 4 key.
2. Pressing the ENTER key.

This display tests the roll keys and command function keys.

How to use this display:

1. Press and hold the upper shift* key while you press either the Roll ↑ or Roll ↓ key.
2. Observe roll lines 1, 2, 3, and 4. You can return lines that have rolled off the display screen by pressing the ENTER key.
3. Observe the intensity of the numbers on the display screen while you perform step 4.
4. Press the CMD key; then press command function key 1. Repeat until command function keys 1 through 12 have been pressed. Press the CMD key again; then press and hold the upper shift* key while pressing command function key 13. Release both keys. Repeat until command function keys 13 through 24 have been pressed.
5. Repeat step 4 to obtain a normal display of the numbers.

Return to the DISPLAY VERIFICATION MENU by:

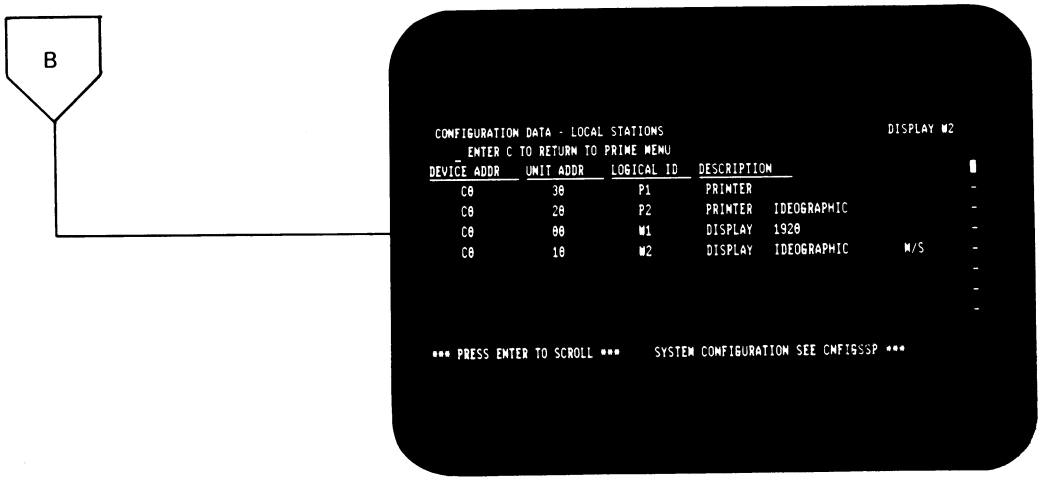
1. Pressing the C key.
2. Pressing the ENTER key.

*On the ideographic keyboard, press ALT SHIFT.

Return to the PRIME OPTION MENU by:

1. Pressing the C key.

2. Pressing the ENTER key.



Station ID (W2, P1 etc) can be as many as 10 characters.

Select CONFIGURATION DATA by:

1. Pressing the 3 key.

2. Pressing the ENTER key.

The descriptions for CONFIGURATION DATA are:

- Device Addr is the address of the controller.
- Unit Addr is the station(s) assigned to the controller. The first digit is the port number and the second digit is the station address.
- Logical ID is the name the system uses to address this station.

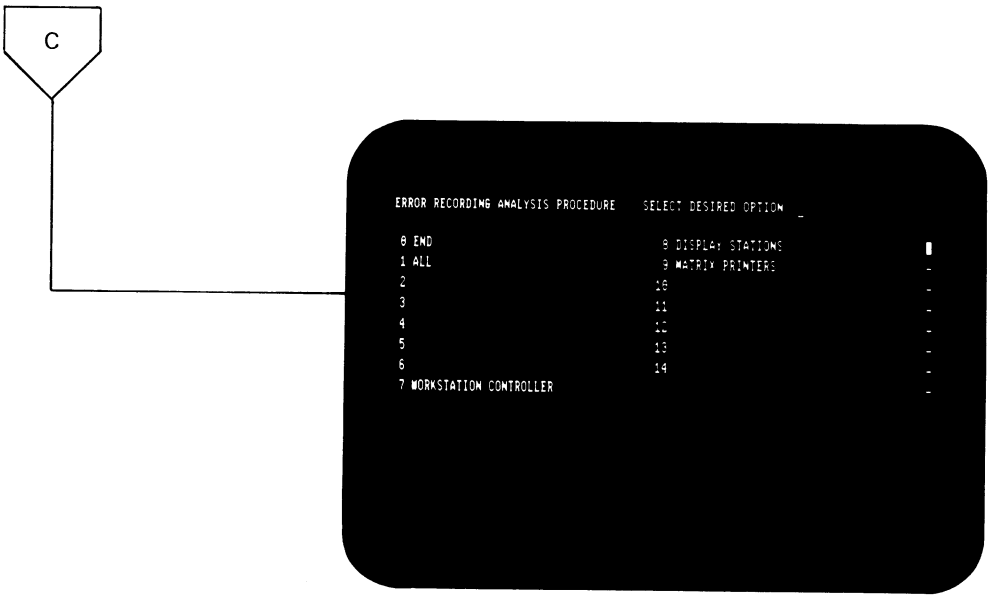
Return to the PRIME OPTION MENU by:

1. Pressing the C key.

2. Pressing the ENTER key.

*(Unit Address) can be as many as three characters. The units position is the physical station address; the two high-order positions are the physical port/cable.

A sample system message is shown in row 12.



Select the ERROR RECORDING ANALYSIS PROCEDURE (ERAP) menu by:

1. Pressing the 4 key.

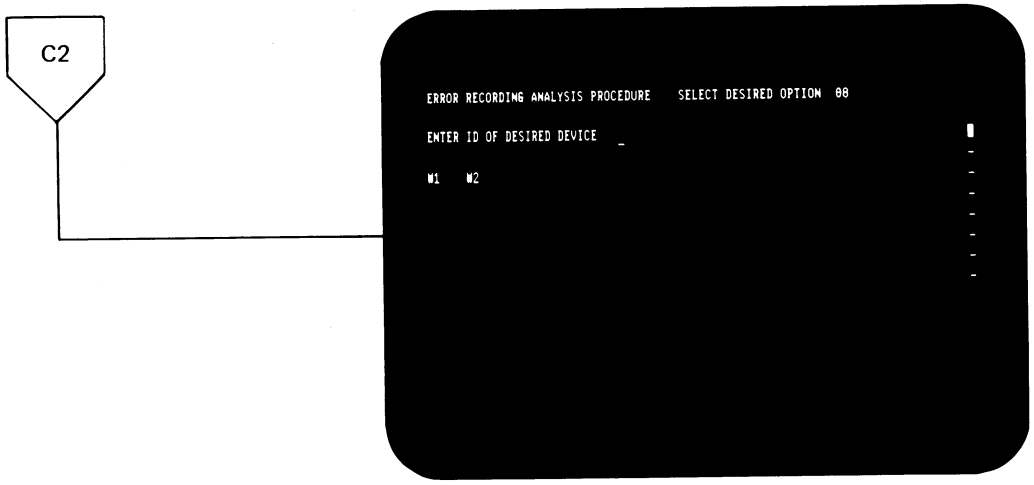
2. Pressing the ENTER key.

Note: For a detailed ERAP description, see the system documents. For display station problem identification, see 208 "Error History Table" in this section.

Descriptions of the ERAP options are:

- If you select the END option, the ERAP function will be terminated. If you select this option and press the Field Exit key, the display returns to the sign-on menu.
- If you select the ALL option, the ERAP tables will be displayed one at a time for all devices on the line. When the error history table for the first device is displayed and the Enter key is pressed, the I/O counter table for the second device will be displayed. This sequence will be repeated until the error history table for the last device on the line is displayed.
- If you select the workstation controller option, the display stations option, or the 5256 printers option, you must also select a particular device. The I/O counter table, the error counter table, and the error history table will be displayed for the selected device only.

This manual describes only the display stations option.

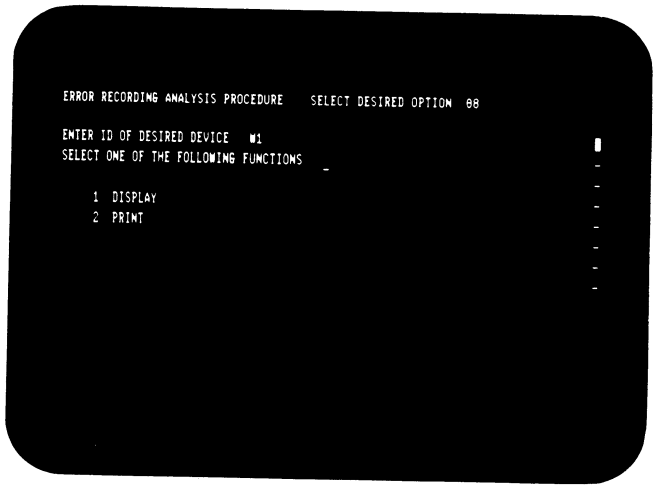


Select the display stations option by:

1. Pressing either the 1 key or the 8 key, depending on the displayed menu.
2. Pressing the FIELD EXIT key.

How to use this display:

1. Enter the ID of the desired device.
2. Press the ENTER key.



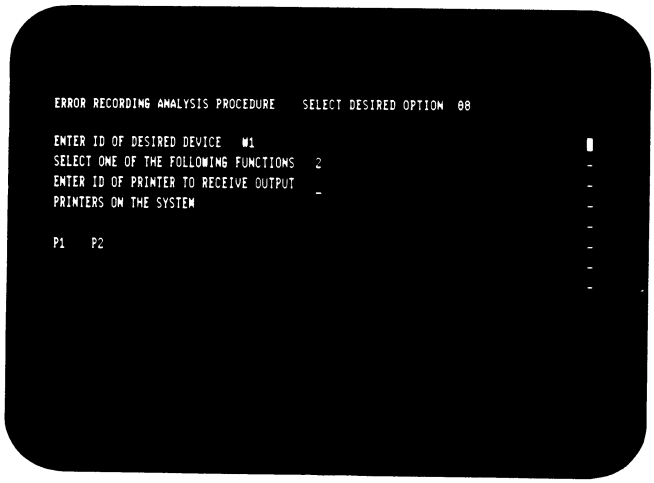
How to use this display:

If you only want to look at the error tables on the display screen:

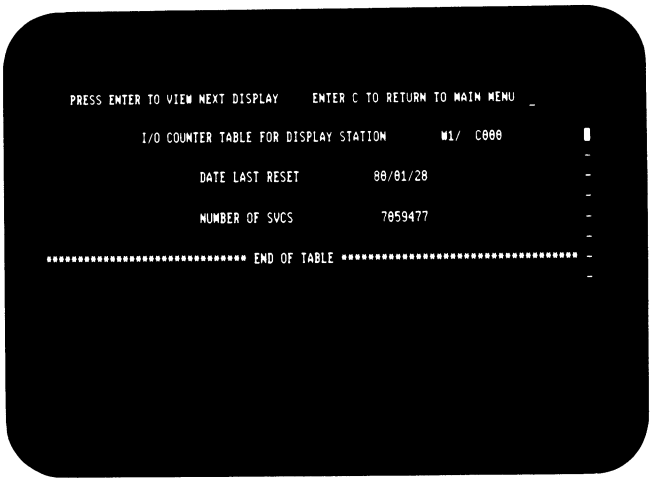
1. Press the 1 key.
2. Press the ENTER key.

If you want a printout of the error tables:

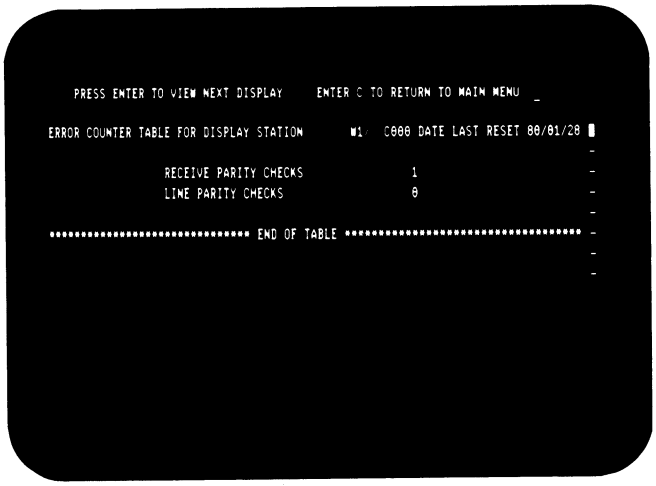
1. Press the 2 key.
2. Press the ENTER key.



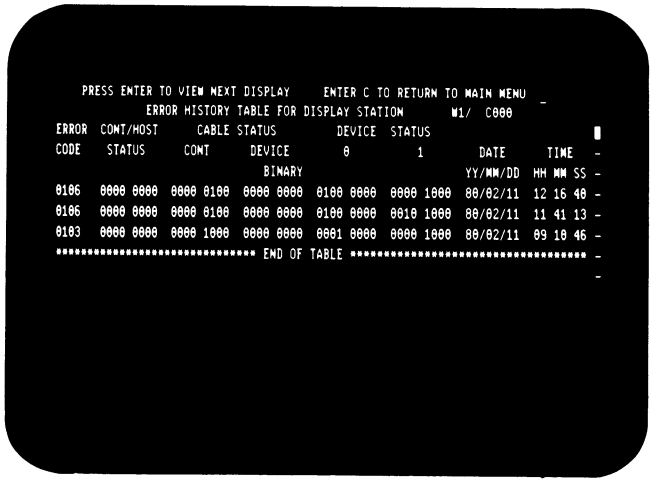
The following three tables may be displayed again or printed again (in order) as many times as desired; you must press the ENTER key after each table has been displayed or printed.



Press the ENTER key.



Press the ENTER key.

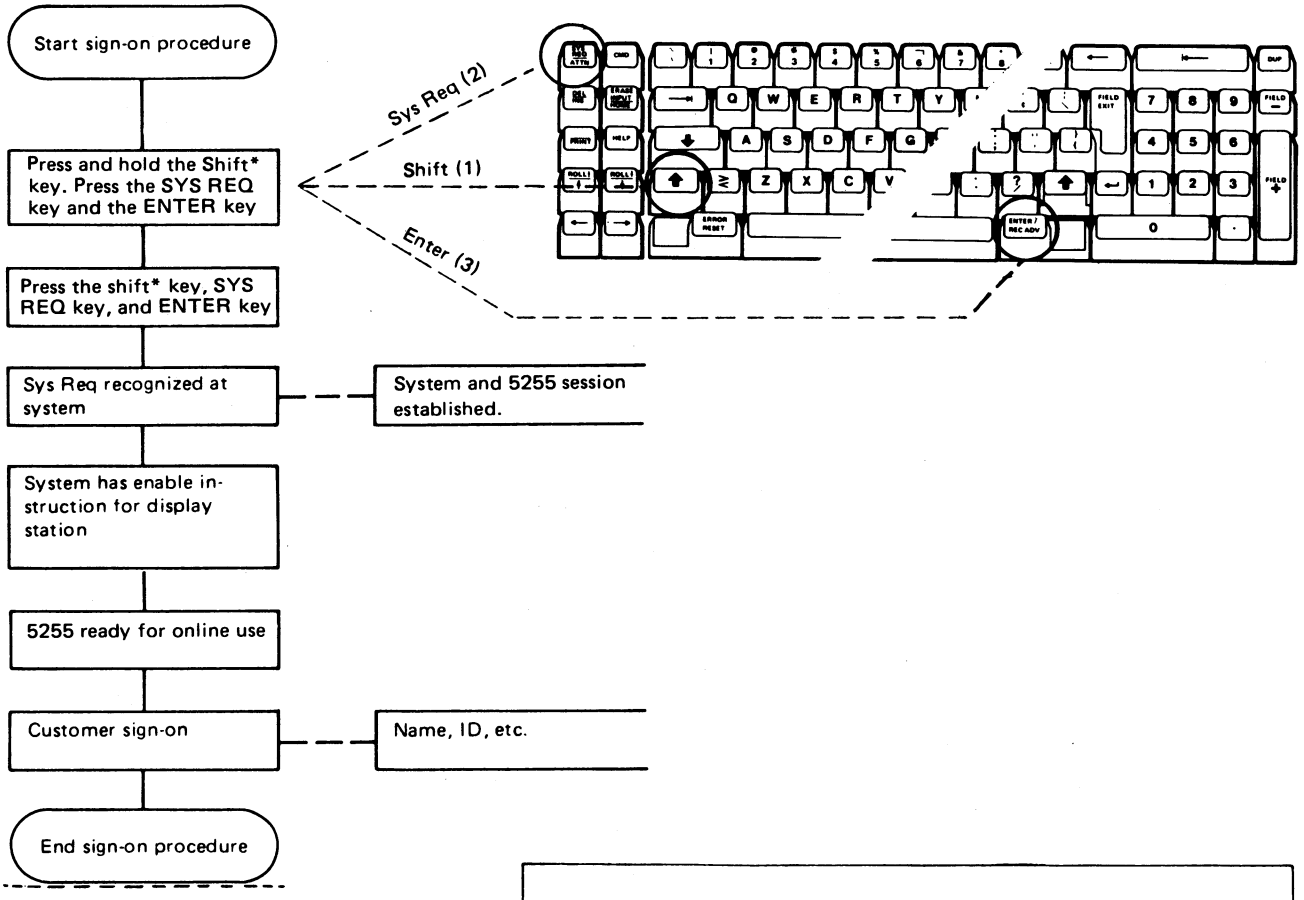


For the identification of display station problems, see reference 208, "Error History Table."

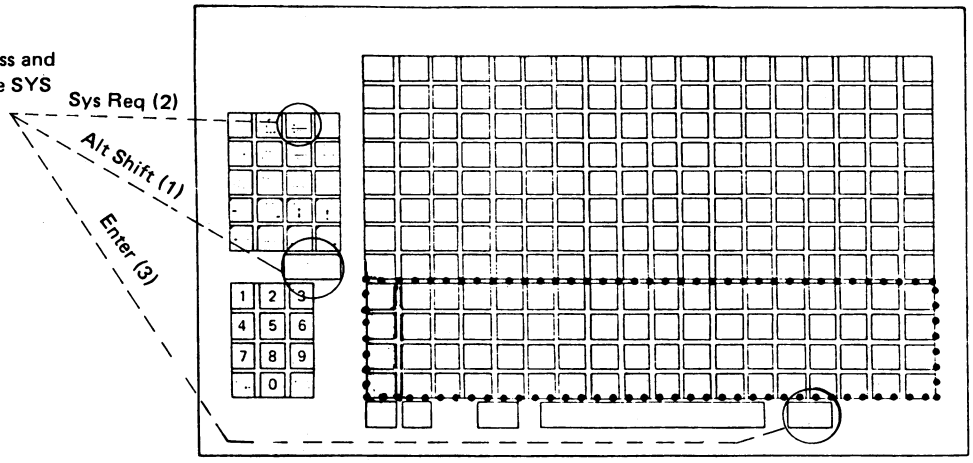
207 SIGN-ON PROCEDURE

This is the procedure that the operator and customer engineer use to sign on to use the display station. It is also a diagnostic in that all parts of the display station, customer system cable, controller, and system must be operating correctly.

The initial program load (IPL) sign-on procedure must be completed before this procedure can be used.

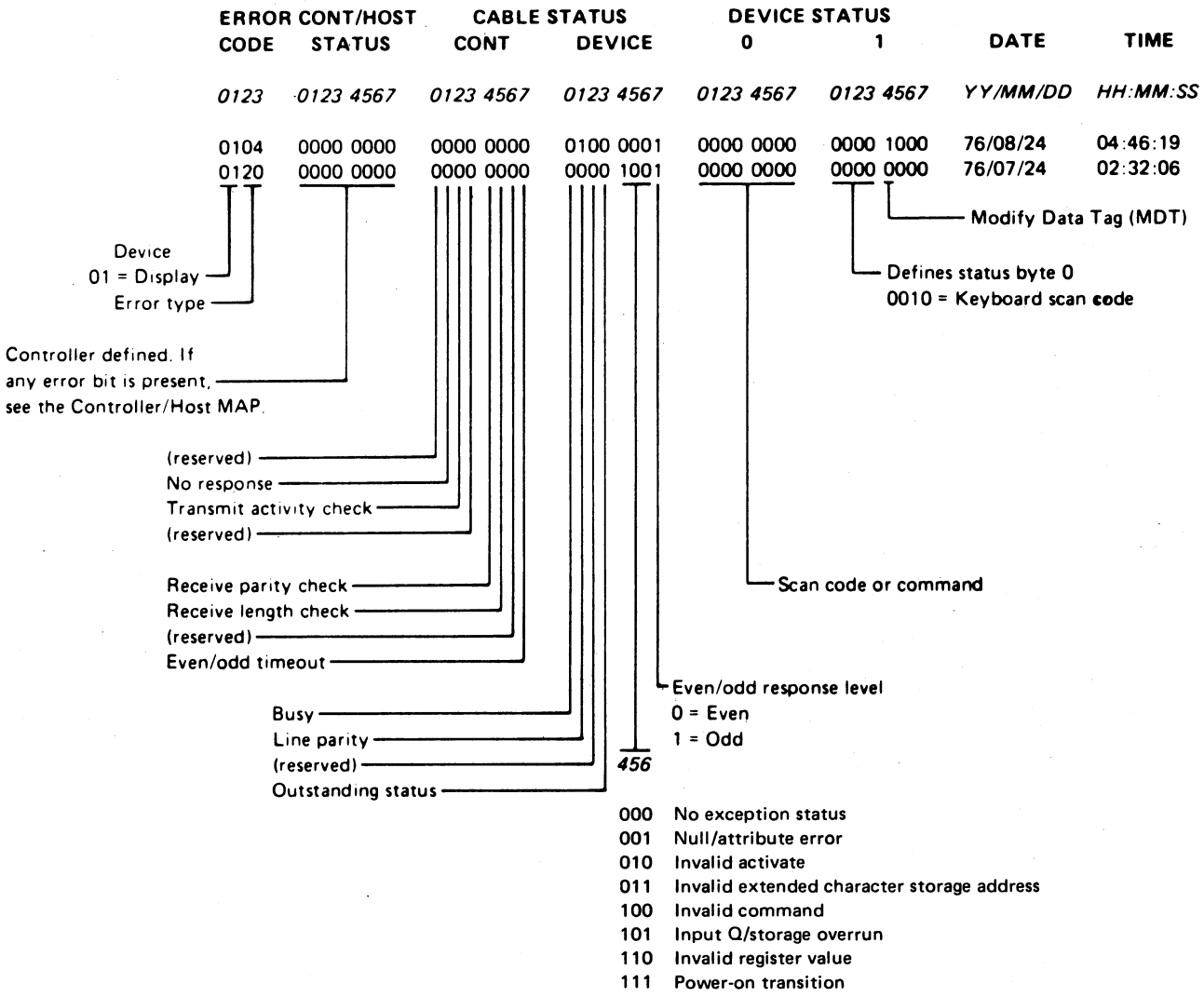


*On the ideographic keyboard, press and hold the ALT SHIFT key. Press the SYS REQ key and the ENTER key.



208 ERROR HISTORY TABLE

This figure is an example of an error history table that describes the fields that can be displayed on the display station or that can be printed on a printer.



209 ERROR CODES

Two types of error codes are described in this section: display station error codes and operator error codes.

Display Station Error Codes

Errors that are relative to hardware failures or the servicing of a display station are listed first. The controller detects these errors by sensing the status sent from the display station or by sensing either no response or a wrong response. Errors are stored in the order in which they are received; they are listed here in groups. The error codes appear on the display screen in the bottom left corner; error code 01xx identifies a display station error. (These numbers blink.)

Line/Interface Errors

0100 No Response

This error is reported if the display station did not respond to a poll when the display station and controller were in session.

0101 Transmit Activity Check

This error is detected by the controller when a poll or command is executed by the controller.

0103 Receive Parity Error

The controller reports this error if the wrong parity was received in response to a poll or command.

0104 Line Parity Check

The display station reports this error if the wrong parity was received in a poll or command.

0106 Receive Length Check

The controller received the wrong number of bytes as a result of a poll or command.

0107 Wrong Station Responded

An incorrect station address was returned in response to a poll from the controller.

0108 Power-On Transition

The status bit was set when the display station was powered on. This error is reported only if the display station was in session.

0109 Activate Command Failure

The controller checked the device status and found that the busy bit was not on after an activate command had been sent.

Keyboard Errors

0111 Scan Code Not Valid

The 8-bit code sent in the keyboard response frame could not be translated to an assigned character or function that was specified by the controller. This code applies to the alphanumeric keyboard only; with the ideographic keyboard, this error code is not used.

Command/Function Errors

0120 Command Not Valid

This condition indicates that the poll/command sent to the display station was not a valid command or that the device ID was not correct.

0121 Register Value Not Valid

This condition indicates that the address counter value was not within the user accessible limits.

0122 Storage or Input Queue Overrun

This condition occurs if more than 16 commands and associated data frames are sent to the display station by the controller, or if an attempt is made to store data in storage that is not accessible to the user.

0123 Null or Attribute Exception

This condition indicates that no attribute was found or that the address counter pointed to an attribute.

0124 Activate Not Valid

This condition indicates that the activate command that was sent to the display station was not valid.

0125 Invalid Extended Character Storage Address

This condition indicates that the first two bytes of data written into the extended character intermediate buffer (during an alternate-entry character transfer) do not contain a valid code point storage address.

0149 Undefined Error Status

This condition indicates that the controller found an error but the cause of the error could not be determined.

0181 Magnetic Stripe Reader Error

This error is indicated if no device word was received by the controller while bit 10 was on.

0182 Device Type Error

This condition indicates that an unsupported device responded to a poll.

0183 Wrong Size Display Assembly

The CRT image size does not match the CRT image size set in the ID word sent by the display station.

0184 Incorrect Keyboard ID

The keyboard ID received by the controller was invalid.

0185 Incorrect Keyboard Specified

The keyboard ID received by the controller does not match the ID in the keyboard table in use for the display station.

0189 Invalid Outstanding Status

An outstanding status was presented in the poll response, and no outstanding status information was available.

Time-Out Errors

0190 Even/Odd Change in Status

This condition indicates that the status sent to the controller from the display station did not change within 225 ms after the controller sent a positive acknowledgment and received a not-busy response.

0191 Busy

This condition indicates that the controller found that the busy bit had been on for a period of more than 400 ms.

Operator Error Codes

These errors are caused when you press the wrong key, press a key that is not recognized by the controller, or enter the wrong data in a specified input field. The error codes appear on the display screen in the bottom left corner; these error codes have a format of 00xx. (These numbers will be blinking.) To display the type of error, press the HELP key.

If an error is displayed and no error condition is present, the most probable cause of the error is the controller. See the system documents for the cause of the error.

However, you can check the error conditions by using the online test (206). For example, the specified input fields display (selected from the Display Verification Menu) contains specific data fields. You can intentionally make errors by entering the wrong data in a field and checking the error condition that appears.

The following list of operator error codes shows the error code number and the description, followed by a description of the cause of the error.

For error recovery on all these errors, press the Error Reset key.

0000 HELP KEY NOT ALLOWED NOW

You pressed the HELP key; however, either no error code was displayed, or the error was issued by a program that does not support the HELP key.

0001 LAST KEYSTROKE NOT RECOGNIZED

You keyed information faster than the controller could receive it; therefore, the last character you entered was not recognized. This is a keyboard overrun.

0002 LAST KEYSTROKE NOT RECOGNIZED

The controller received a key code that is not valid and does not know what key you pressed.

0003 INVALID KEY FOLLOWED CMD KEY

You pressed the CMD key, but the next key you pressed was not one of the command function keys.

0004 MSR INPUT ONLY

You have tried to enter data from the keyboard into a field where entry only from a Magnetic Stripe Reader is allowed.

0005 CURSOR IN PROTECTED AREA OF DISPLAY

You attempted to enter data; however, the cursor was not in an input field on the display. Data cannot be entered in a protected area of the display.

Move the cursor to a field in which the data can be entered and enter the data.

0006 INVALID KEY FOLLOWED SYS REQ KEY

You pressed an invalid key after pressing the SYS REQ key and prior to pressing the ENTER key or the ERROR RESET key.

0007 MANDATORY ENTER FIELD—MUST ENTER DATA

There is at least one mandatory enter field on the display; you must enter data into this field before the display can be changed or moved.

0008 THIS FIELD REQUIRES ALPHABETIC CHARACTERS

The field into which you are now attempting to enter data requires alphabetic data, and you pressed a key that was not an alphabetic key.

Valid characters are A through Z, blank, comma, period, hyphen, and apostrophe. The DUP key can be used to duplicate these characters into this field.

0009 THIS FIELD REQUIRES NUMERIC CHARACTERS

The field into which you are now attempting to enter data requires numeric data, and you pressed a nonnumeric key.

Valid characters are 0 through 9, blank, comma, period, plus, and minus. The DUP key can be used to duplicate these characters into this field.

0010 ONLY CHARACTERS 0 THROUGH 9 ALLOWED

The field into which you are now attempting to enter data requires signed numeric data, and you pressed some other key.

Valid characters are 0 through 9. The DUP key can be used to duplicate these characters into this field.

0011 INVALID KEY FOR SIGN POSITION OF FIELD

You attempted to enter data into the last position of a signed numeric field.

0012 INSERT MODE–NO ROOM TO INSERT DATA

Either there is no room in this field for additional data, or the cursor is in the last position of the field.

Do not use the Insert mode to change the data or to enter the last character into this field.

0013 INSERT MODE–ONLY DATA KEYS ALLOWED

You have attempted to leave a field while the display station was still in insert mode.

0014 MANDATORY FILL FIELD–MUST FILL TO EXIT

You pressed a function key that is supposed to move the cursor out of this field; however, the cursor is not in the first or last position of this mandatory fill field. A mandatory fill field must be completely filled unless you exit from the first position in the field before data has been entered into the field.

Enter data to the end of the field or move the cursor to the start of the field and then use the FIELD –, FIELD +, or FIELD EXIT key to blank all of the field.

0015 CHECK DIGIT ERROR

The number and the check digit you entered did not compare.

If the number you entered matches the input, continue without using that input.

0016 FIELD MINUS KEY INVALID WITH THIS FIELD

You pressed the FIELD – key, but the field you are in is not a signed numeric field.

You can either continue to enter data or press the FIELD EXIT key to leave the field.

0017 MANDATORY FILL FIELD–KEY USED INVALIDLY

You pressed the FIELD –, FIELD +, or FIELD EXIT key; however, the cursor was not in the first or last position of this mandatory fill field. A mandatory fill field must be completely filled unless you exit from the first position in the field before data has been entered into the field.

Enter data to the end of the field or move the cursor to the start of the field and then use the FIELD –, FIELD +, or FIELD EXIT key to blank all of the field.

0018 INVALID KEY USED TO EXIT THIS FIELD

The cursor is in the last position of this field. You must use a key that is not a data key to leave this field; for example, you can use the FIELD EXIT key.

0019 DUP KEY NOT ALLOWED IN THIS FIELD

You pressed the DUP key; however, the DUP key is not permitted to be used in this field.

0020 FUNCTION KEY NOT ALLOWED IN THIS FIELD

While in either a right adjust or a signed numeric field you pressed a function control key that is not permitted to be used in this field; you must exit from the field before pressing one of the following keys: ENTER/REC ADV, PRINT, HELP, ROLL ↑, ROLL ↓, HOME (when the cursor is in the home position), and the command function keys including Clear and Test Request.

Continue by pressing the FIELD +, FIELD –, or the FIELD EXIT key; then press the function control key.

0021 MANDATORY ENTER FIELD–MUST ENTER DATA

The cursor is located in a mandatory enter field, and you attempted to exit from the field without entering data. A mandatory enter field must have data entered in it before you can exit from the field.

0022 STATUS OF FIELD NOT KNOWN

A system error has occurred. The status of the present field is not known. This error can occur when a delete or insert operation is attempted.

Clear the error and continue without using the undefined key.

0027 KEY NOT DEFINED–KEY CANNOT BE USED

You pressed a key or selected a shift position on a key that is not defined by this system.

0031 WSC BUFFER OVERFLOW

The data on the MSR card was not within the specified length for MSR.

Continue without using that MSR card.

0032 DATA ERRORS ON COAX LINE

A 16-byte block of data was not transferred.

Retry the MSR card. If the error recurs, continue without using that MSR card.

0033 SECURED DATA NOT AUTHORIZED

The MSR data received was secured data; however, this field was not specified for secured data in the FCW.

Ensure that you are in the correct field. Retry the MSR card. If the error recurs, continue without using that MSR card.

0034 MSR WILL NOT FIT IN ACTIVE INPUT FIELD

The data received from the MSR by the controller will not fit in the field.

Retry the MSR card. If the error occurs again, continue without using that MSR card.

0035 MSR ERROR

Bit 8 of the MSR data is on.

Retry the MSR card. If the error recurs continue without using that MSR card.

0038 MSR INPUT NOT ALLOWED IN 2-BYTE FIELDS

You tried to use the Magnetic Stripe Reader in an ideographic field. (The only place this is allowed is 1-byte *either* fields.) To recover, press ERROR RESET. Use the MSR with alphanumeric fields only.

0060 ALPHANUMERIC DATA NOT ALLOWED

You have tried to enter alphanumeric data into a field that allows only 2-byte data characters.

To recover, press ERROR RESET and continue, entering 2-byte data in this field or subfield.

0061 IDEOGRAPHIC DATA NOT TRANSLATED

You have tried to enter ideographic (2-byte) data into a field that allows only alphanumeric (1-byte) data characters, but the 2-byte character does not have a 1-byte equivalent.

To recover, press the ERROR RESET key and continue, entering 1-byte data in this field or subfield.

0062 INVALID DATA TYPE CHANGE

You have tried to change the data type, but the cursor is not in an *open* field or the first enterable position of an *either* field.

To recover, press the ERROR RESET key. Position the cursor in the first *enterable* position of the field.

0063 INVALID IDEOGRAPHIC NUMBER

You have tried to enter an invalid ideographic number while in alternate entry mode.

To recover, verify that the code you wish to enter is valid. Press the ERROR RESET key, and enter the code for a valid 2-byte character.

0064 KEY NOT DEFINED FOR CURRENT MODE OR SHIFT

The key you just pressed is not valid in the current mode or shift.

To recover, press the ERROR RESET key. Press only keys that are valid in your current mode or shift.

0065 RESERVED FOR SHIFT CHARACTER

The column into which you are trying to key data is reserved for a shift-out or shift-in character.

To recover, press the ERROR RESET key. To verify the start and end of the 2-byte field or subfield, press the DISPLY OE/OF CHAR key; this allows you to see where shift-out and shift-in characters are located.

0066 INVALID REPEAT OPERATION

You tried to use the REP key to repeat a shift or attribute character. (Only data characters can be repeated with the REP key.)

To recover, press the ERROR RESET key. Continue, without the use of the REP key.

0097 TEST REQUEST NOT AVAILABLE

The programming required for the test request function is not installed in the host system.

0099 KEY NOT VALID AT THIS TIME

The key you pressed is not valid at this time. Either the program or utility would not recognize the key, or you pressed a function key before pressing the SYS REQ key.

Continue without using the key that caused the error. If you have not yet used the system request functions, the SYS REQ key is the only valid function key at this time.

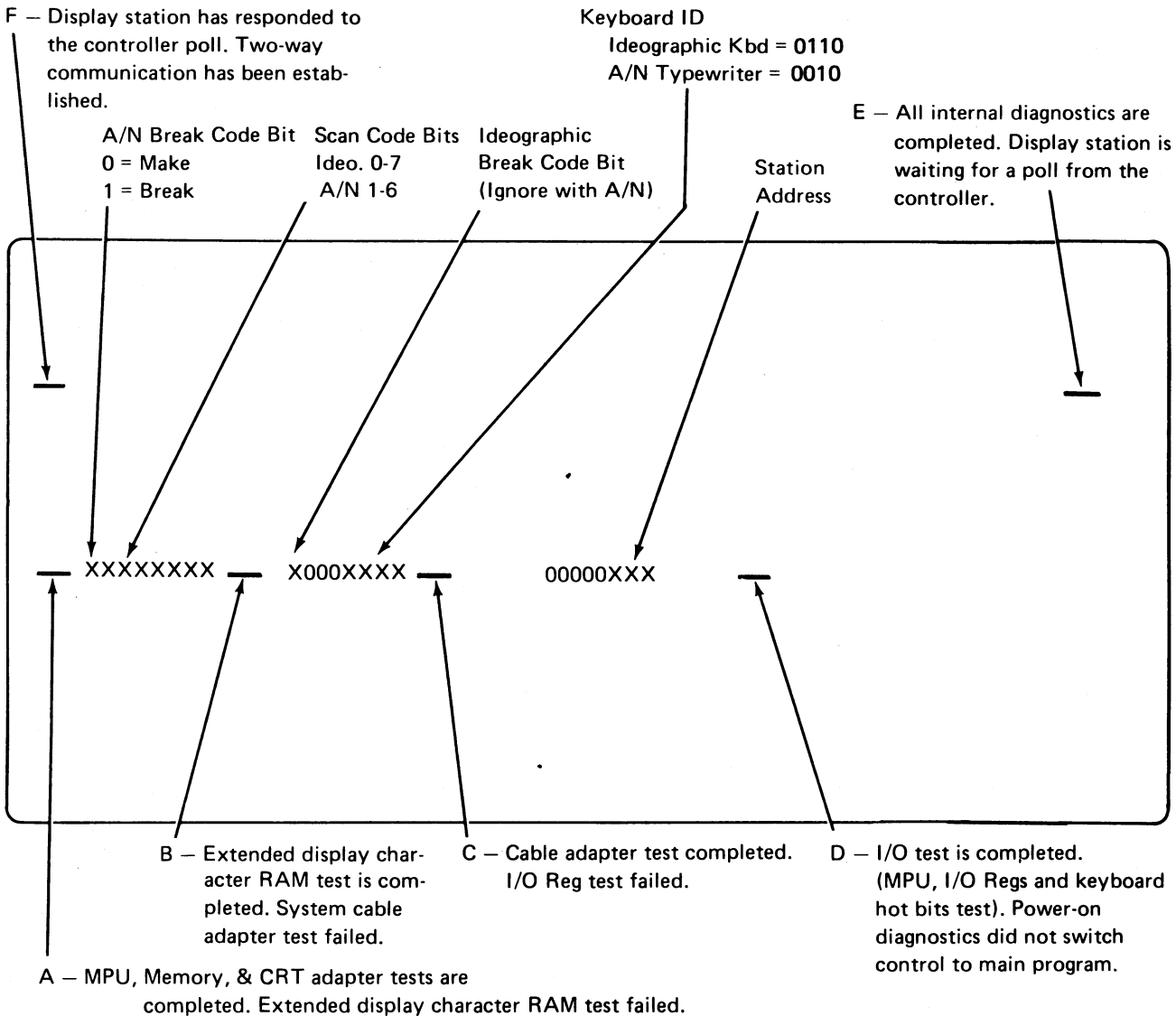
Note: When this error occurs, the display station is in the free-key mode. The free-key mode is described in reference 205.

210 DIAGNOSTIC DISPLAY LOCATIONS

211 (NOT USED)

This figure shows the possible positions of the cursor during the power-on sequence. If the cursor is in position A, B, C, or D, the power-on diagnostic did not finish. If the cursor is in position E the power-on diagnostic finished; however, the display station is not in session with the host system. If the cursor is in position F, the power-on diagnostic finished, and the display station is in session with the host system.

Cursor Display Positions and Test Mode Data Fields



212 TROUBLESHOOTING AIDS

Mini-MAPs provide you with three levels of information. These levels are:

1. A description of the circuit and how it can be tested.

2. A figure showing the circuit line names and pin numbers.

3. A detailed guide that uses the yes and no path of questions that you can follow to isolate the failures.

This procedure is used to give you as much information as possible about the failing circuit.

It is possible for the symptoms to change or disappear while you are probing an intermittent problem.

All the diagrams use the same format.

Conditions After Power On

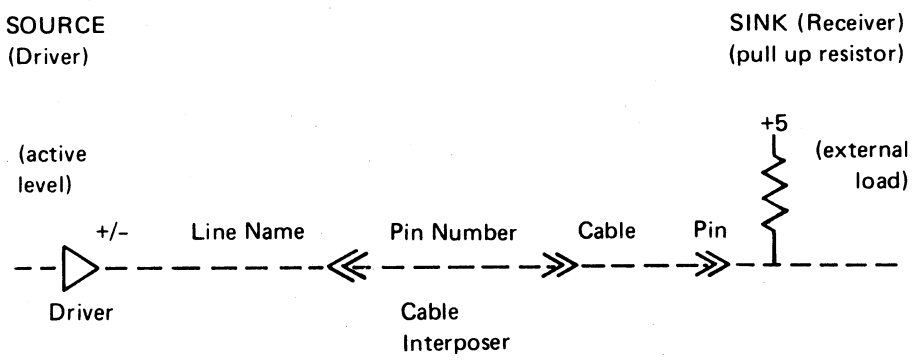
Describes the normal condition of the circuit after power on.

Service Aids

Lists suggestions as to how the circuit may be tested and additional information about the circuit.

Tools

Suggests which tools to use.



212 (continued)

Mini-MAP example

Is the signal present at the driver?
Y N

Is the line at a Down level?
Y N

– Replace the driver.

The line could be either grounded or logically driven to the Down level by the driver.
– Check for a ground.
Is the line grounded?
Y N

– Replace the driver.

– Replace the FRU that caused the ground.

Note: A pull-up resistor at the receiver will cause an Up level at the receiver if the cable is open.

Is the signal present at the receiver?
Y N

– Repair or replace the interposer or cable.

Is this the last signal line to be checked?
Y N

– Go through the same procedure for any other lines called out by the MAP.

– Replace the receiver.

Suggested action for an intermittent problem:

- Analyze the suspected line; inspect all the connector contacts.

- Replacement sequence:
  – FRU A
  – FRU B

Note: The FRUs are listed in the order in which they should be replaced.

Preventive Maintenance

Preventive maintenance is not needed on the display station.

Tools and Test Equipment

The following tools and test equipment are needed to service the 5255 Display Station:

1. CE general logic probe

2. Standard CE tool kit

   This kit contains tools that are normally used by the customer engineer.

3. Metric tool kit

   You can order a kit of metric tools from Mechanicsburg by ordering bill of material 1749235.

   Note: In the display station, all metric screws are blue.

4. Fiber screwdriver

   You need a fiber screwdriver to adjust the potentiometers on the cathode-ray tube. You can order this screwdriver by ordering part 460811. (This tool is now being supplied in the standard tool kit.)

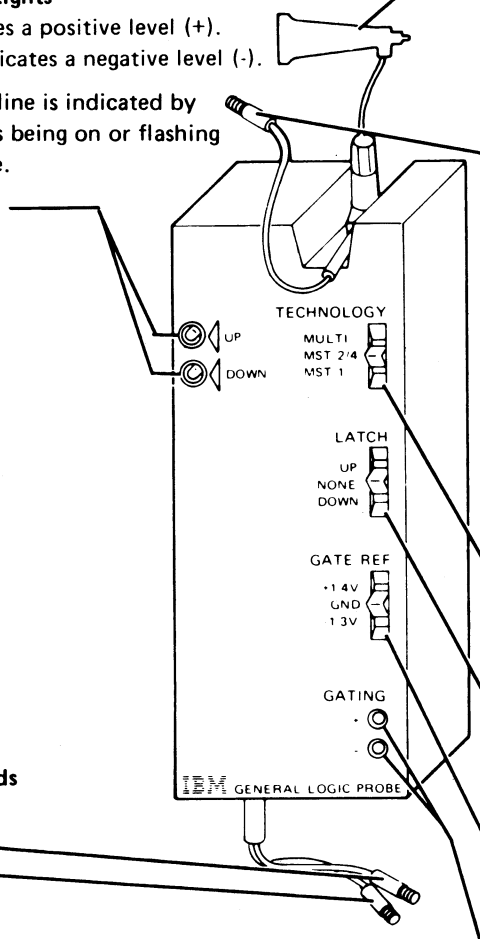
5. Keytop removal tool (part 9900373)

CE GENERAL LOGIC PROBE (Part 453212)

The universal logic probe provides a visual indication of a line level. (Refer to the handbook that comes with the probe.)

Indicator Lights
UP indicates a positive level (+).
DOWN indicates a negative level (-).

A pulsing line is indicated by both lights being on or flashing at any rate.



Power Leads

+Red
-Black

CAUTION
Improper connection of the power leads might cause the probe to malfunction.

(For the following connection locations, see 103.)
Connect the black (—) lead to 1-G-D08 (ground).
Connect the red (+) lead to 1-G-D03.

A voltage difference ranging from 4V to 12V is needed to power the probe. The black lead is always the most negative.

Test Terminal

The line being probed is connected to this terminal.

Note: To avoid improper indications, this lead should not be placed near the high-voltage transformer or near the neck of the cathode-ray tube (150).

Ground Lead

CAUTION
Connect this lead to any signal ground near the probe point. Do not use frame ground.

Improper indications result if this lead is *not* connected to signal ground.

Note: In order to avoid improper indications, the lead should not be placed near the high-voltage transformer or near the neck of the cathode-ray tube (150).

Logic Selector (TECHNOLOGY)

Use the MULTI setting for the display station.

Latch Switch

The UP position allows the UP light to be latched on a positive pulse. The DOWN position allows the DOWN light to be latched on a negative pulse. The NONE position resets the lights and prevents any latching action. The NONE position is used for most probing within the display station.

Gate Ref Volts Switch

Set the Gate Ref Switch to ground (GND) unless MAP procedures direct otherwise.

Gating Terminals

Introduction

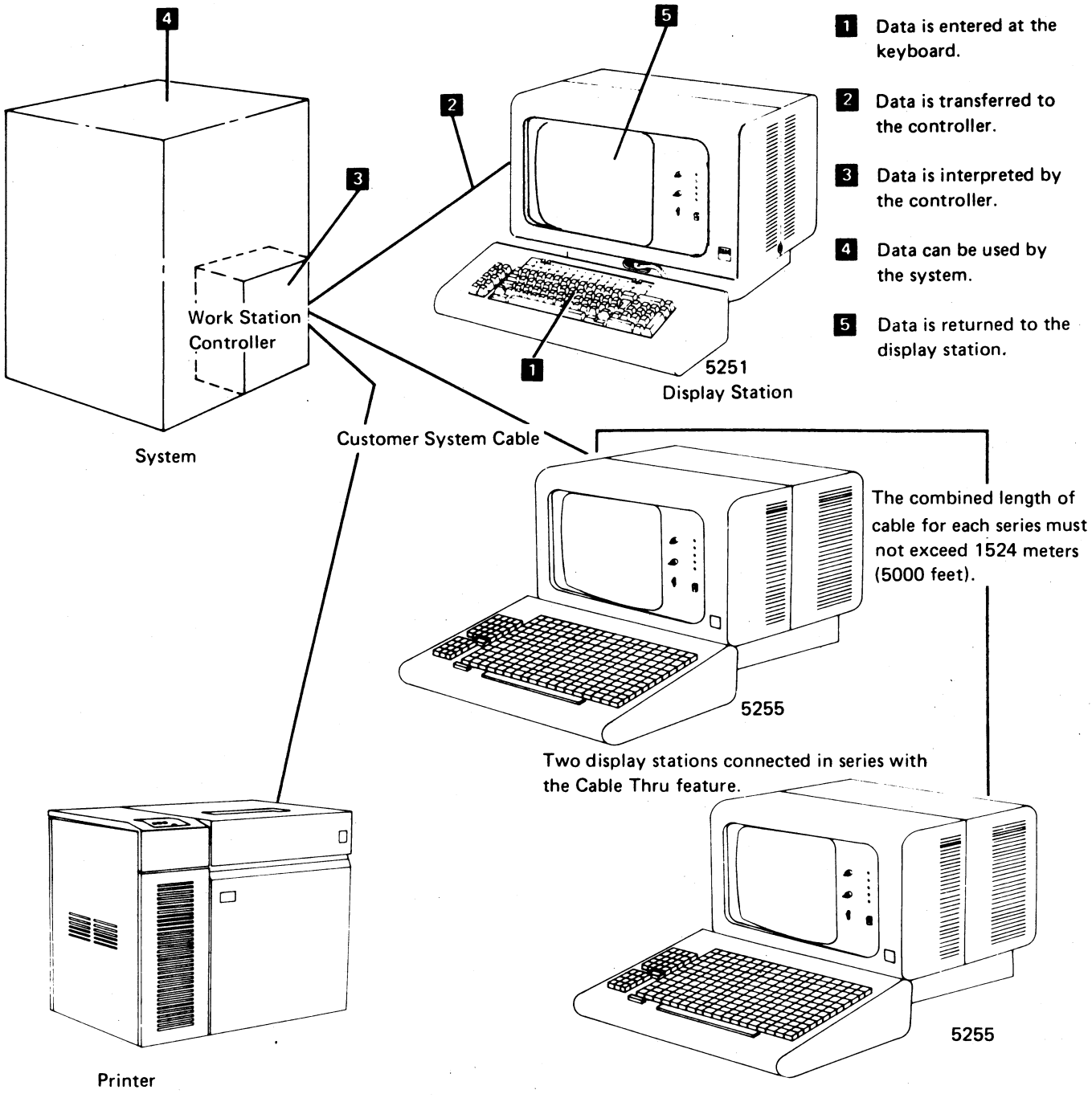
The IBM 5255 Display Station is a tabletop, online work station that is used for data entry or interactive display functions. The display station contains a display screen that displays data, a keyboard that is used to enter data, a control unit that contains storage, and a cable adapter that handles the communications between the controller and the display station.

The 5255 displays up to 960 alphanumeric characters in 12 rows of 80 characters each. For improved readability, each row contains double the scan lines of other 5250 display stations. Each ideographic character requires two alphanumeric character positions providing a maximum screen display of 479 ideographic characters and one control (SO) character.

SYSTEM CONFIGURATION

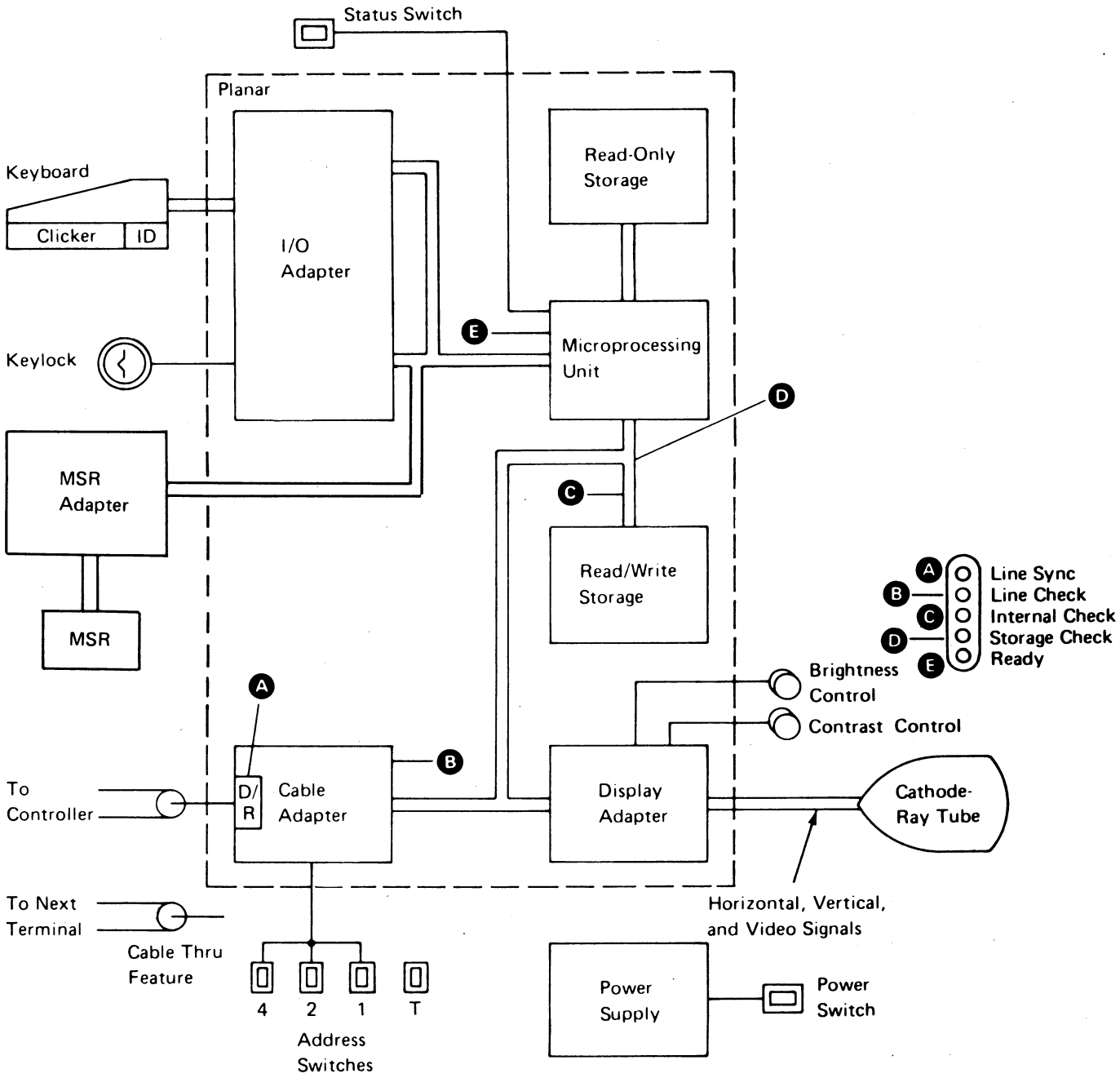
The following figure shows a configuration containing 5255 Display Stations attached to a controller at a system location. The number of display stations that are attached to the system is specified during system configuration. Display stations and printers can be attached in a point-to-point configuration, or they can be attached in a series configuration by means of a Cable Thru feature that is installed on each work station in the configuration.

Display stations rely on a controller and a system. Data entered at the keyboard **1** is moved to the microprocessing unit, and then to the cable adapter; the data is then serially shifted on the system cable to the controller **2**. After the controller receives the data, it translates it **3** or sends it to the system **4**. The data is then returned to the display station where it is displayed **5**.


Data Flow
1 Data is entered at the keyboard.
2 Data is transferred to the controller.
3 Data is interpreted by the controller.
4 Data can be used by the system.
5 Data is returned to the display station.
Work Station Controller
System
5251 Display Station
Customer System Cable
The combined length of cable for each series must not exceed 1524 meters (5000 feet).
5255
Two display stations connected in series with the Cable Thru feature.
5255
Printer

Data Flow

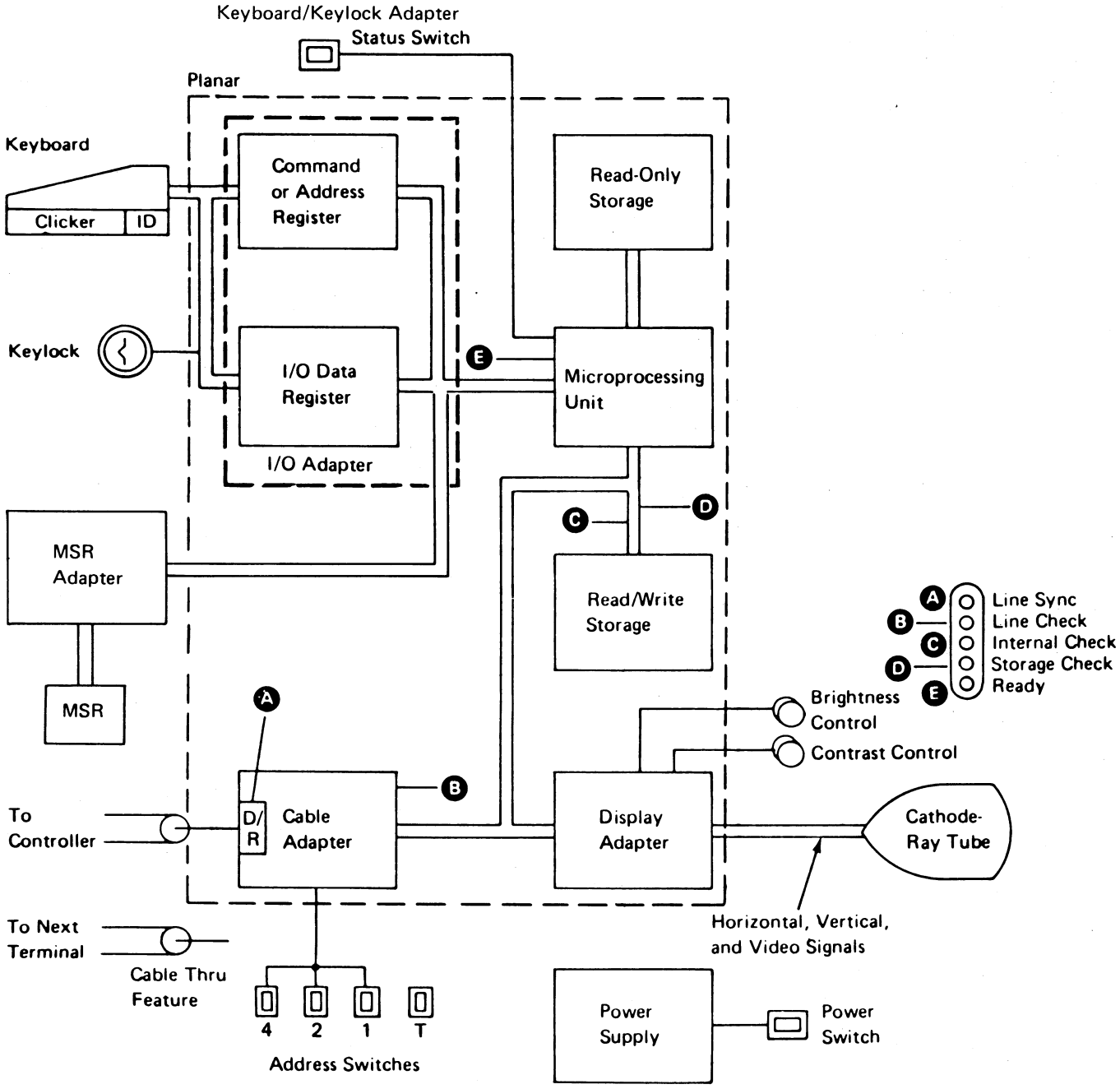
The next figure shows the data flow of the display station. The following pages of this section describe functions performed in each of the major sections of the display station. Gating, parity checking, counters, and parity generation are not shown in the data flow.



Functional Units

I/O ADAPTER CONTROL

The I/O adapter control is composed of a group of registers that control the interface and address functions of the I/O devices. These registers are controlled by the MPU (microprocessing unit) and are loaded with data from the I/O devices. The data is moved to read/write storage by the MPU.



Keyboard

The keyboard has three major parts: key modules, pad printed circuit board, and logic printed circuit board. Key modules, including the keytops, are the "switches" the operator presses. A pad printed circuit board below the key modules senses the pressed key by capacitive coupling. The logic printed circuit board, which is connected to the pad printed circuit board, contains the scan counter; this converts the pressed key to a scan code.

The scan code is loaded into an eight-position buffer on the logic printed circuit board when the keyboard signals the keyboard adapter control that a keystroke is ready to be sent. A strobe pulse moves the keystroke scan code to the keyboard adapter. The scan code moves through the display station to the controller. The controller interprets and converts the scan code to the appropriate character indicated on the keyboard. The keyboard identification specifies how the scan code is interpreted.

Typamatic keys load the character buffer with a scan code for each scan code cycle. The typamatic key operates at a rate of 10 to 15 repeated operations per second (600 ms first cycle time).

Note: On the alphanumeric keyboard, most of the keys – including the data keys – have typamatic action. On the ideographic keyboard, only the spacebar and the cursor-movement keys have typamatic action.

On the alphanumeric keyboard, the shift and shiftlock keys generate not only a make code but also a break code pulse. The break code tells the controller that there is a change in shift status.

On the ideographic keyboard, *all* keys emit a scan code with a make signal when pressed and the same scan code with a break signal when released. The keyboard shift is set upon the make of a shift key. When this make is received, the keyboard shift status is calculated by the host system according to the following priority scheme:

1. A/N Shift
2. Upper Shift Key
3. Shift Lock Key
4. Shift Specified by Field Format Word (FFW)

A shift-key-generated shift is reset upon the release (break) of the shift key. The shift lock key is active only when it is held down (made) during the break of the upper shift key. With no shift keys held down and the shift lock not set, the keyboard shift is in accordance with the Field Format Word.

Clicker

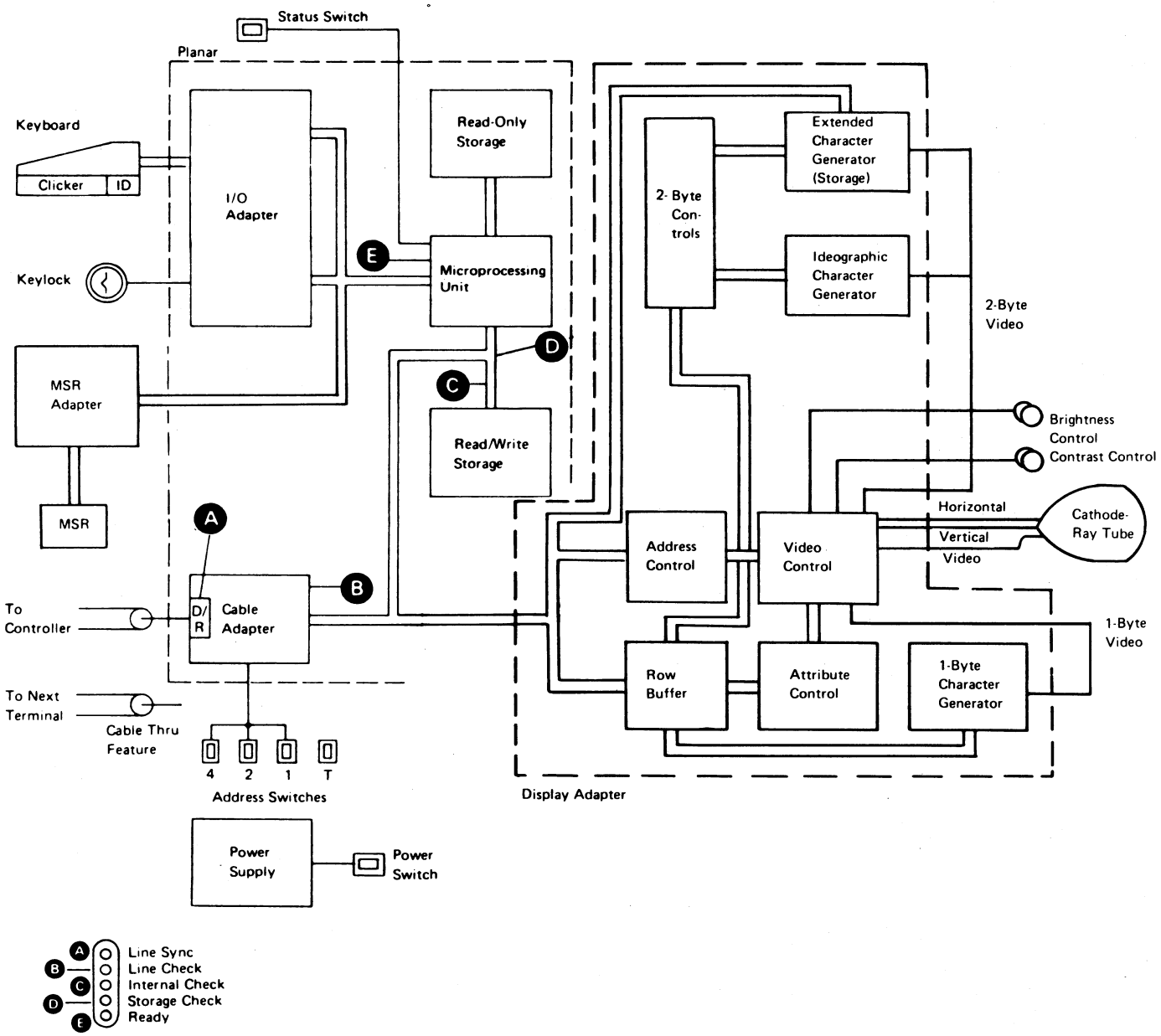
A solenoid attached to the keyboard is activated after the data has been sent from the logic printed circuit board and has been stored by the MPU. The sound of the solenoid is an aid to the operator because it indicates that the next key may be pressed. Also, an alarm function can be performed by this solenoid when the keyboard adapter sends a series of pulses to the solenoid.

Keyboard Identification

When requested, a 4-bit ID code is sent to the controller. The ID code tells the controller which keyboard is being used. The ID code is set up when pins are jumpered on a plug board on the keyboard logic printed circuit board.

DISPLAY ADAPTER

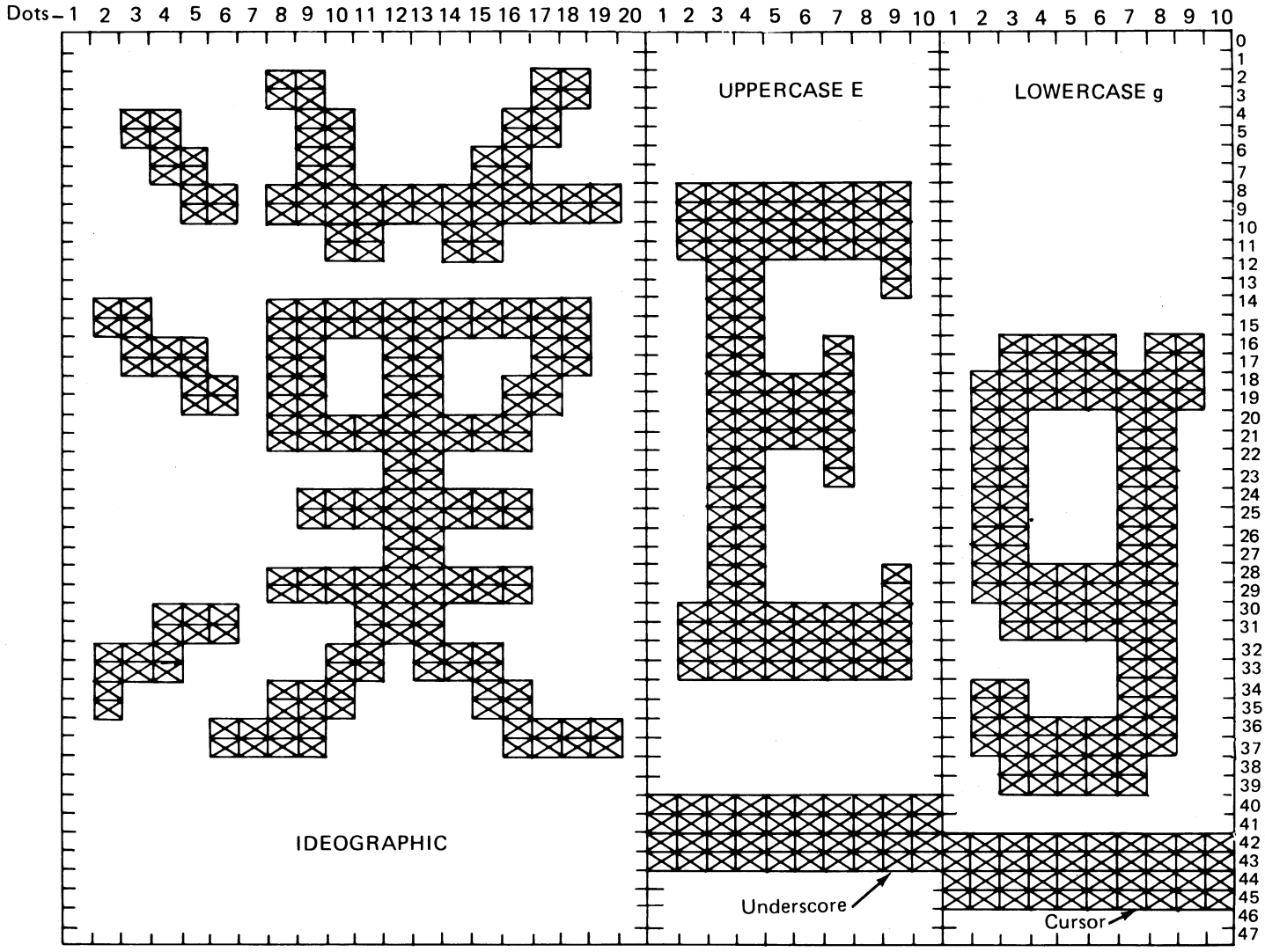
The display adapter contains the circuits that control the video, horizontal, and vertical drive signals for the display assembly.



Buffering and Displaying

Data that is to be displayed is contained in read/write storage. The display adapter addresses the read/write storage area for this data, moves the data to one of the 2-row buffers in the display adapter, converts the data into a dot pattern by means of a character generator, and shifts the pattern by means of a video signal line to the cathode-ray tube. At the same time, the display adapter determines the display position and converts the position into the vertical and horizontal drive signals needed for the cathode-ray tube. This routine is constantly repeated to refresh the display. The generated character is made up of dots. Vertical dots are approximately two times as close together as horizontal dots and are formed by two cathode-ray tube scans.

Each A/N (1-byte) character is formed by a matrix of eight dots by 16 dots located within a maximum possible space of 10 dots by 24 dots. The unused dots provide the horizontal and vertical space between the characters. Ideographic (2-byte) characters have a generated matrix of 18 by 18 dots within a maximum possible space of 20 dots by 24 dots. It is also possible to display large-image ideographic characters. These are formed by using the entire 20 by 24 dot area.



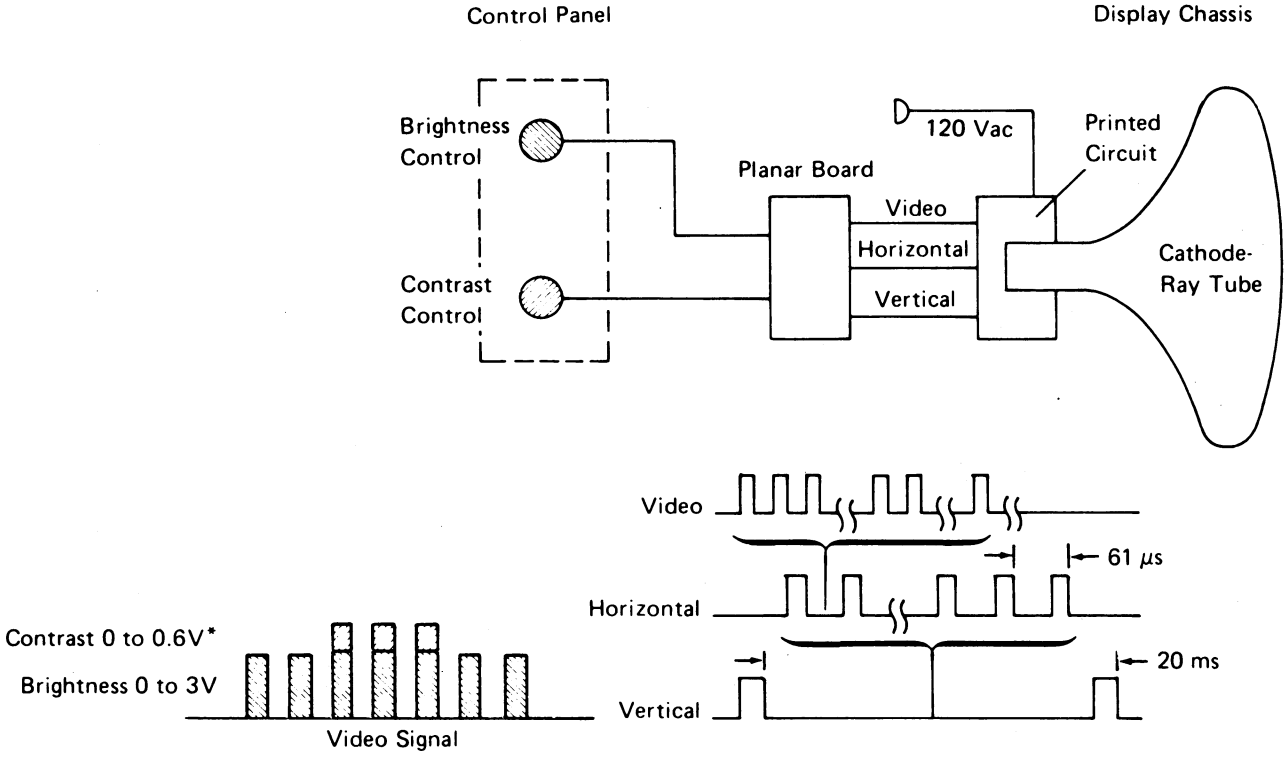
The ideographic character window is 20 dots wide by 48 scans* high. The character matrix is 18 dots wide by 36 scans* high (excluding the cursor).

The A/N character window is 10 dots wide by 48 scans* high. The character matrix is 8 dots wide by 32 scans* high (excluding the underscore or cursor).

*Two CRT scans make one vertical dot.

CONTROL PANEL

The control panel has two display controls. The Brightness control determines the light difference between the displayed data and the remainder of the display screen. The Contrast control determines the brightness of the field intensified by the intensity field attribute. Both controls determine the voltage level of the video signal at the main planar.



*0 to 0.6V is added to the Brightness level voltage.

DISPLAY SCREEN

Field Attributes

Field attributes control how data in a field will be displayed on the display screen. They control display blinking, intensity, underscoring, column separation, reverse image, and no display. The application program controls field attributes. After power on, field attributes default to normal intensity, no blinking, no underscoring, no column separators, and no reverse image when the screen is refreshed. Field attributes occupy one character space position; this position is the first character of the field.

Display Screen Indicators

These indicators appear on the display screen. A bright square indicates the *on* condition, and a line indicates the *off* condition. The controller controls all the indicators except the System Available indicator. Power on resets all the indicators.

When the display screen indicators are on, they indicate the following:

- System Available – indicates that the display station has received a poll or a command. This indicator disappears if the display station does not receive a poll or command within 200 ms.
- Message Waiting – indicates that a message is waiting for the operator.
- Keyboard Shift – indicates that the display station is in upper (numeric) shift.
- Ideographic Mode – indicates that the 5255 (with the ideographic keyboard) is able to accept entry of ideographic characters from data-and-shift key combinations.
- Alternate Entry Mode – indicates that the 5255 (with the ideographic keyboard) is able to accept entry of ideographic extended character numbers from the shift key pad.
- Insert Mode – indicates that the INS key has started an operation.
- Input Inhibited – indicates that the system cannot process a keyboard scan code.

A cursor, which is controlled by the MPU or controller, indicates where the next keyboard character will be shown on the display screen.

CABLE ADAPTER

The cable adapter consists of the hardware (drivers, receivers, and logic) on the planar board; this hardware handles the incoming and outgoing communications between the controller and the display station.

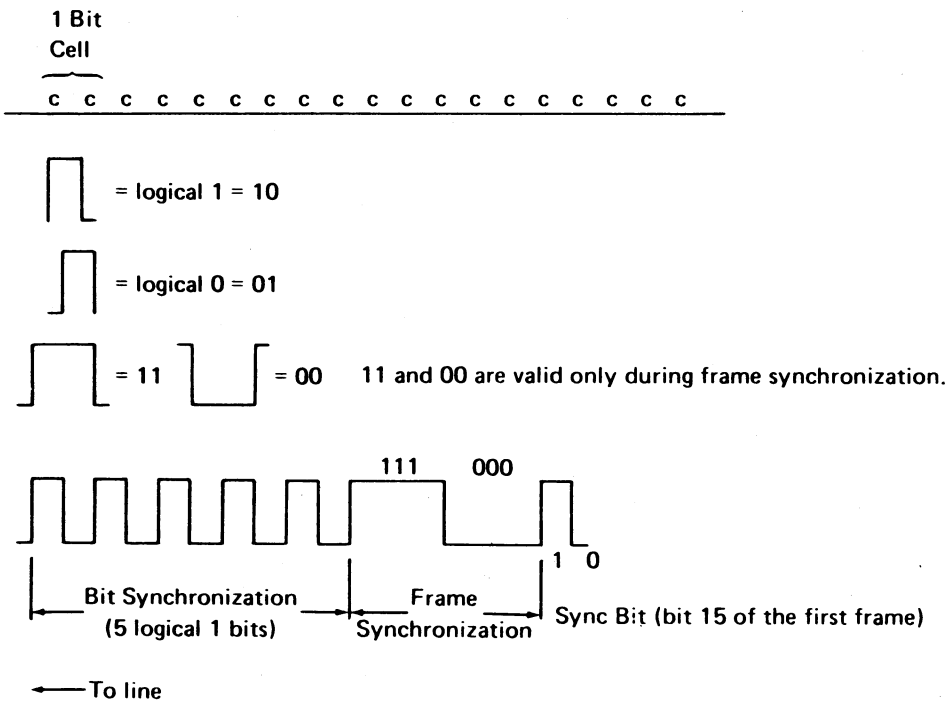
Note: A system cable connects the display station to the controller. See "System Cable" in the "Maintenance Procedures" section of this manual and "Cable Thru" in the "Features" section.

The 16-Bit Frame

Communications between the controller and the cable adapter at the display station are carried by 16-bit frames that are sent to and from the controller as needed. The system cable carries no signal between frames.

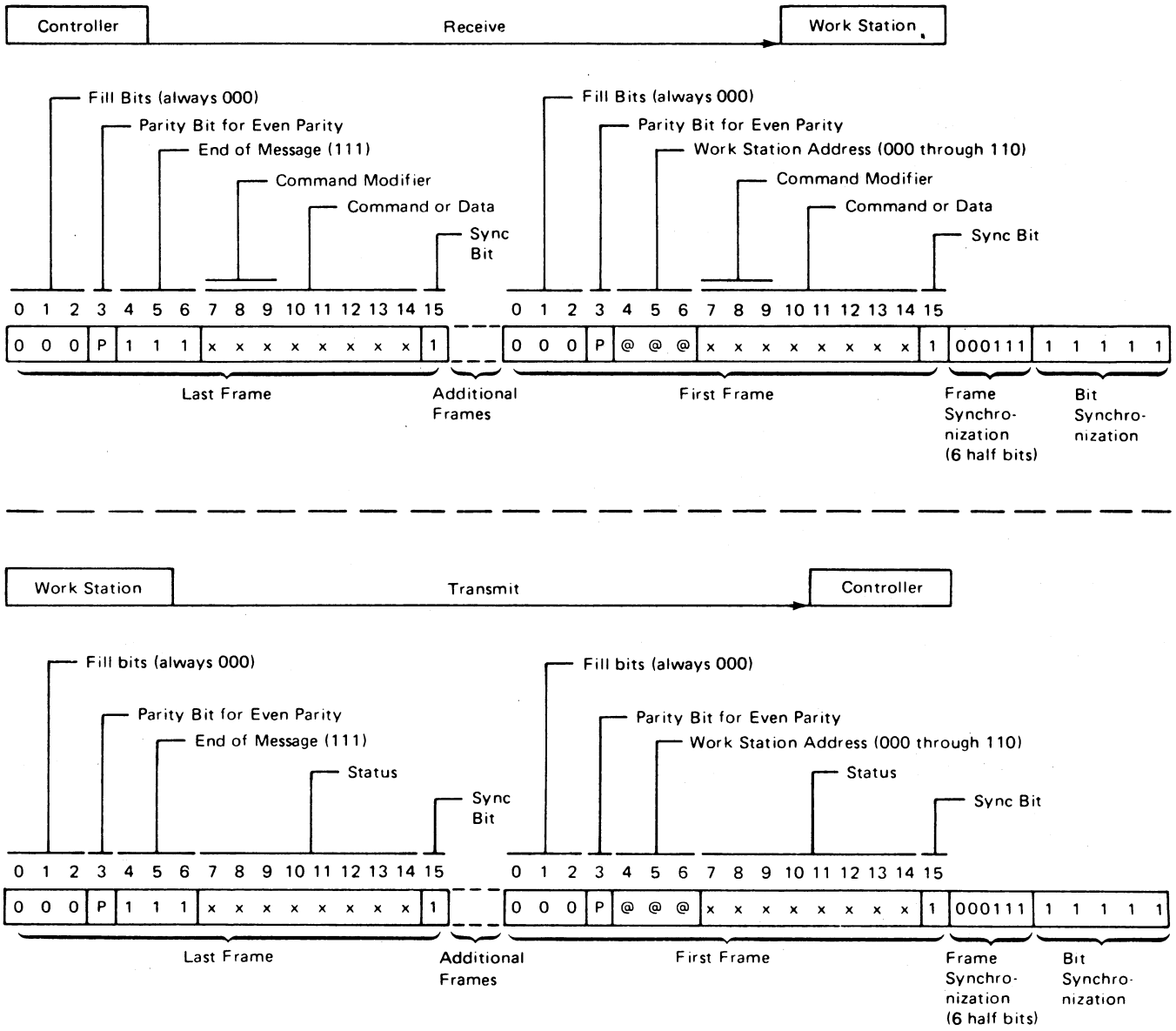
To understand what is to follow, it is necessary to describe briefly the phase encoding used for sending data on the system cable. The data is phase encoded so that a transition occurs during each bit time (a 0 to 1 transition is used for a 0 and a 1 to 0 transition is used for a 1). Because the transition divides the bit into two parts, the term *half bit* will be used in the description that follows. (The data is sent through the system cable in the form of a four-level signal. Refer to the system documents for more information on the phase encoding process.)

When information is to be sent on the cable, a group of *five 1 bits (1010101010 half bits) is sent* to establish bit synchronization. Immediately after the 1 bits have been sent, a group of three half bit 1's and three half bit 0's is sent to establish frame synchronization. After the frame synchronization half bits have been sent, the frame is sent; the sync bit is sent first.



The maximum transmission rate is 1.0 MHz (16 microseconds per frame). The meaning of each bit of the frame during transmit and receive is shown in the following figure:

Transmission Sequences



The 16-bit frame carries 13 bits of information in each direction. The fill bits, which are always 000, serve as a timing delay. The parity bit makes the active bits in the frame even. The display station decodes the address bits and responds to a specific address. The display station sends a response frame that contains the display station address. A display station address of 111 indicates an end of message and causes a line turnaround. At the work station, line turnaround extends from the time the last bit of a frame (bit 0) has been received until the time the same work station starts sending bit and frame synchronization patterns. Bits 7 through 14 contain the data or commands used by the display station and storage. Bit 15, which is always on, is the synchronization bit for both the controller and the display station.

Commands

Note: The binary number in parentheses next to the command is combined in bits 10 through 14 of the command frame.

Clear (10010): clears the addressed feature or display station from the present value of the address counter to the present value of the reference counter.

EOQ (00010): indicates the end of the command queue. Bits 8 and 9 of the command frame must be on (1). Only polls will be recognized until a not busy status is returned to the controller in response to a poll.

Insert Character (00011): is followed by one or more (up to 15) data frames containing the character (or character count and characters) to be inserted at the address counter location.

Load Address Counter (10101): is followed by two data words and causes bits 7 through 14 of the data words to be written in the address counter.

Load Cursor Register (10111): is followed by two data words and causes bits 7 through 14 of the data words to be written in the cursor register.

Load Reference Counter (00111): is followed by two data words and causes bits 7 through 14 of the data words to be written in the reference counter.

Move Data (00110): moves data, to the reference counter address, between limits set by the value of the address counter and the value of the cursor register.

Poll (10000): is sent from the controller to the display station and starts the transmission of a one- or three-frame response. The poll command responds to and resets a line parity error from the display station. It also responds to the last status transmission from the display station.

Read Activate (00000): this command is sent after the setup specified by a read command is completed and starts the transmission of requested data.

Write Activate (00001): this command immediately precedes the data transmitted by the controller after the work station has been set up by a write command and causes the work station to start receiving the data from the controller.

Read Base ID (0000 1100):* request the retransmission of one ID word to the Model 2 or 12. This command can be used by the Models 2 and 12 to determine the characteristics of attached work stations.

Read Between Limits (11010):* causes data to be returned from an area in read/write storage; this area is inside the limits of the address counter register and the reference counter register.

Read Data (01000):* starts the transmission of one byte of data from the display station to the controller.

Read Field Immediate (11001):* is followed by 2 data bytes that contain the starting address of the read. Data is transferred from that address until the next screen attribute is reached.

Read Keyboard ID (101100):* determines the type of keyboard and country.

Read MSR (10011000):* request the transfer of the next 16 frames of magnetic stripe reader data.

Read Registers (11100):* starts the transmission of six data words containing the contents of the three control registers.

Read to End of Line (01010):* requests a response from the display station; this response consists of one display line of data from the read/write storage.

Reset (00010): sets the attributes to normal and moves the cursor to the upper left corner. A specific address feature can reset selected portions of the display station, or the controller can send the display station address for a complete station reset.

Reset MSR (10010010): resets the magnetic stripe reader hardware.

Search Next Attribute (00100): causes the display station to search read/write storage for the next attribute.

Search Next Null (10100): causes the display station to search read/write storage for the next null.

*Commands that must be followed by either a read activate or a write activate command.

Search to Multiple Argument (11011): followed by two data frames that are the arguments of the search; search begins at the value of the address counter and proceeds towards the reference counter until either argument is found or until the reference counter is reached and examined.

Set Mode (10011): causes the display station to receive one word that is specified as a mode control. This command must be sent before the 5255 makes any multiframe response.

Write Data (11110):* causes the addressed feature to store all the data words following its accompanying activate command; the address counter advances once for each word stored. This command may be used to load the extended character RAM of the 5255 Display Station.

Write Control Data (00101):* followed by 1 data byte, which controls the display screen to conditionally reset the exception status, control the keyboard clicker during input inhibit, control the audible alarm, input cursor display, blink the cursor, and reverse image.

Write Data and Load Cursor (10001):* followed by 1 to 14 data frames. Data is written to the location address counter, the address counter is incremented, and the cursor register is updated to the new value in the address counter.

Write Data and Load Cursor to the Indicators and Switches (1010001):* followed by 1 data byte, which contains the control information for the display screen indicators.

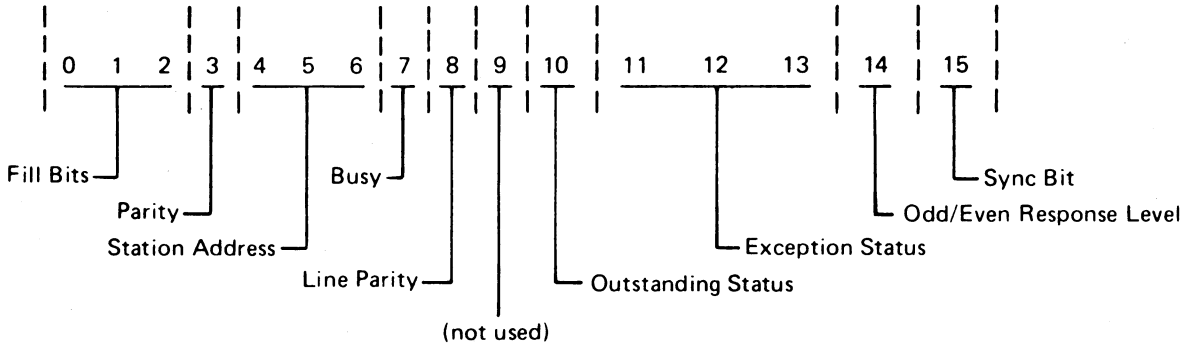
Write Immediate Data (11101):* causes the display station to store all the data the controller sends. If there is more data than the storage area can contain, a storage overrun error occurs.

*Commands that must be followed by either a read activate or a write activate command.

Response Frame

A response frame is returned to the controller after the display station has been polled following a power-on reset. The controller receives the first response frame and returns a set mode command. A three-frame response is made to every poll command after the set mode command has been executed.

Frame 1: The first frame in the response contains the following status information:



Bit 7
0 = Display station not busy
1 = Display station busy

Bit 8
0 = No line parity error found
1 = Line parity error found

Bit 10
Indicates there is feature data to be sent or status data from an I/O device to the controller.

Bits 11, 12, and 13

These three bits are encoded to indicate the following exception status:

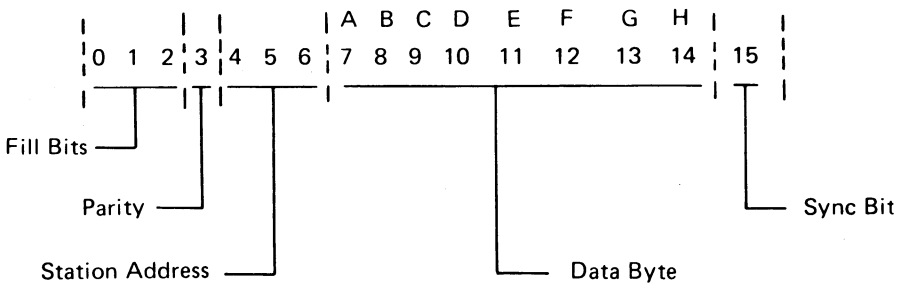
Bit	11	12	13	Description
	0	0	0	No exception status
	0	0	1	Null or attribute error
	0	1	0	Activate command not valid
	0	1	1	Extended character direct storage load error (Invalid alternate entry mode pointer)
	1	0	0	Command or device ID not valid
	1	0	1	Input queue or storage overrun
	1	1	0	Register value not valid
	1	1	1	Power-on transition

Bit 14

By analyzing bit 14, the controller can determine if the information in the received response frame is the same as the information in the preceding response frame, or if the information has changed. Bit 14 is set to zero (0) after power on. Any change in the response frame changes bit 14 from its preceding condition.

Frame 2: With the alphanumaric keyboard attached, the second frame contains a break code in bit 7 and the scan code in bits 8 through 14. With the ideographic keyboard attached, the second byte of response frame 2 is the 8-bit scan code. For both keyboards, if no scan code is available for transmission, bits 7 through 14 are set to zeros. If a keyboard overrun occurs, bits 7 through 14 are all 1s.

Frame 3: The third frame in the response contains a station address, which consists of all 1s if it is the last frame of the message; otherwise, the third frame contains the following information:



Data byte bit assignment:

A Keyboard break code bit when the ideographic keyboard is attached.

B When set, this bit signals the attaching system to invert bits **7 through 14 of the second response frame.**

C 1
D 0
E 0
F 1 — Keyboard identification (Ideographic keyboard ID shown)
G 1
H 0

Interface

The following figure shows the action and synchronization between a display station and controller. All exchanges are started from the controller by a command. The flow is in two directions (one direction at a time).

Controller 5255

Poll for Status

Poll (See note 1.) →
← Base Status (See note 1.)
← Key Scan Code (See note 4.)
← Break Code/Keyboard ID (See notes 2 and 3.)

- The controller initiates a poll sequence.
- Base status of busy or not busy is returned to the controller.
- After a set-mode command has been issued, base status is followed by a key scan code frame and a break code/kbd ID frame. When the display station has no scan code to move to the controller, zeros are transferred.
- If a keyboard overrun occurs, a scan code of all 1's is returned.
- The keyboard identifies itself as alphanumeric or ideographic.
- The controller translates the scan code; a 'write data and load cursor' command returns the scan code to the display station.

Write Data 5255

Write (See note 1.) →
Poll (See note 2.) →
← Base Status (busy) (See note 1.)
← Keyboard Scan Code (See note 4.)
← Break Code/Keyboard ID (See notes 2 and 3.)
Poll (See note 1.) →
← Base Status (not busy) (See note 1.)
← Keyboard Scan Code (See note 4.)
← Break Code/Keyboard ID (See notes 2 and 3.)
Activate (See note 1.) →
Data →
Data (See note 2.) →

- A write operation is initiated and handled the same as a read operation; the only difference is that the data is transferred from the controller to the display station.

←— An arrow indicates the exchange of one 16-bit frame in the indicated direction.

Controller 5255

Read Data

Read (See note 1.) →
Poll (See note 2.) →
← Base Status (busy) (See note 1.)
← Keyboard Scan Code (See note 4.)
← Break Code/Keyboard ID (See notes 2 and 3.)
Poll (See note 1.) →
← Base Status (not busy) (See note 1.)
← Keyboard Scan Code (See note 4.)
← Break Code/Keyboard ID (See notes 2 and 3.)
Activate (See note 1.) →
← Data (See notes 1 and 2.)

- The controller initiates a read operation.
- The display station receives a poll frame and responds with a busy base status frame and an automatic keyboard status frame. The display station, at this time, is moving data queues in preparation for the next operation.
- The controller continues to poll the display station until it responds with a base status of not busy.
- The controller issues an active command to start the read operation.
- The display station shifts the requested data through the system cable to the controller.

Notes:

1. The frame contains synchronization and instructions to switch the display station or controller to the Receive mode.
2. The frame contains an end-of-message delimiter: station ID or all ones (111).
3. For definition, see "Response Frame" (third frame), above.
4. On the alphanumeric keyboard, the scan code is bits 8-14; on the ideographic keyboard, the scan code is bits 7-14.

Data Transfer

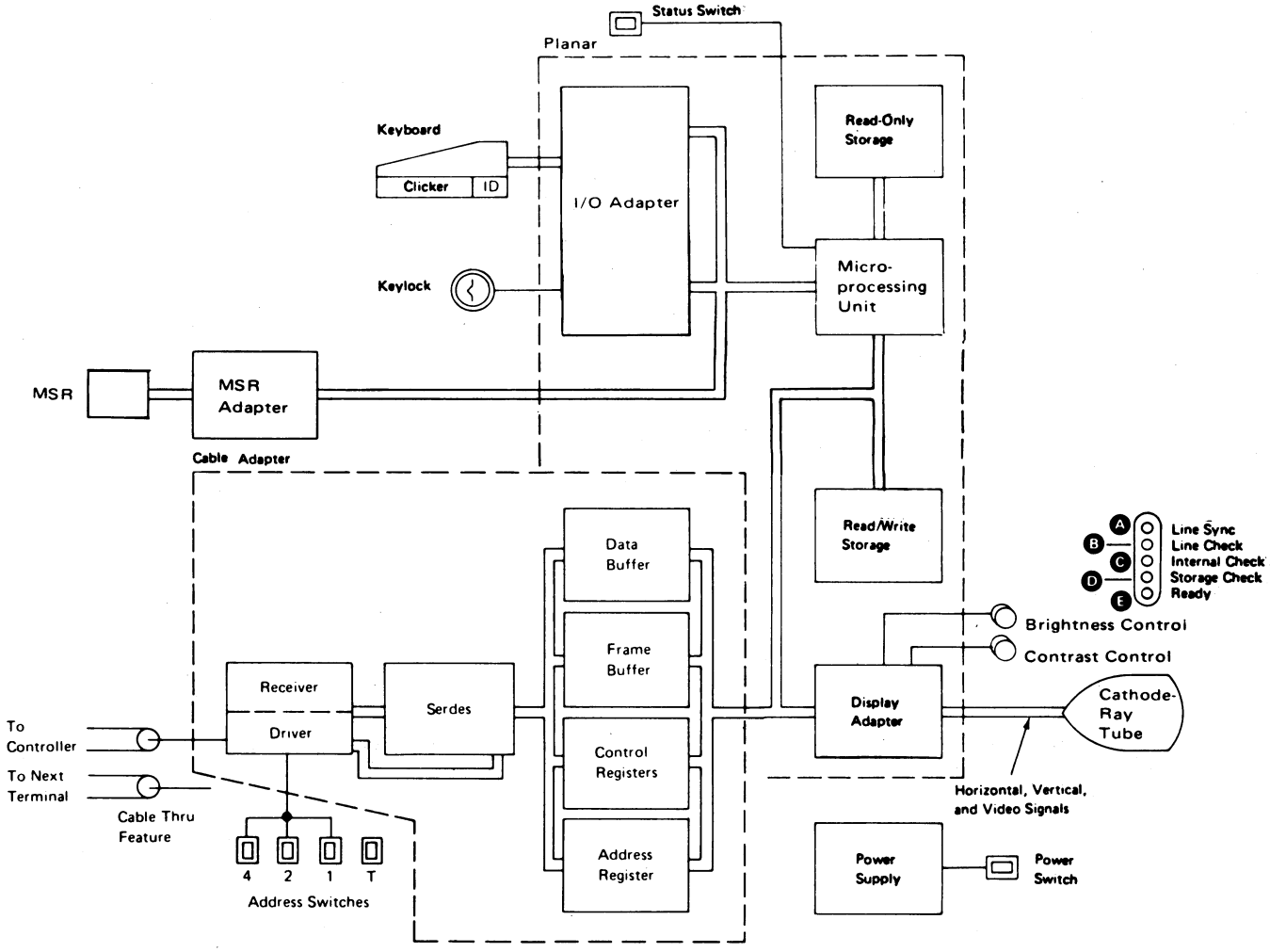
During data transfer, the cable adapter has the three following major functions:

1. To respond to polling
2. To shift data to the customer system cable for transmission to the controller
3. To receive frames from the cable and decode the frames to determine whether they contain commands or data

The cable adapter finds the display station address on the first frame of the transmitted message. The address for a single online display station is 000. When the address has been received and recognized and a response has been returned, polling is complete.

Data to be transmitted to the controller is moved, under control of the cable adapter, from read/write storage, through a serdes (serializer/deserializer) register, to the customer system cable.

Received data is moved into the serdes until the sync bit is in the high-order position. The serdes is stopped; this stoppage allows time for the data to be moved to read/write storage.



MICROPROCESSING UNIT (MPU)

The MPU (microprocessing unit) is the control center of the display station. The MPU receives data from the keyboard and from input/output controls. The MPU controls the displaying of data and the flow of information to and from the controller. It is a processing unit that is controlled by a microprogram. It performs internal machine operations such as testing and comparing data, checking for machine errors, operating the I/O devices, and storing and getting data from read/write storage.

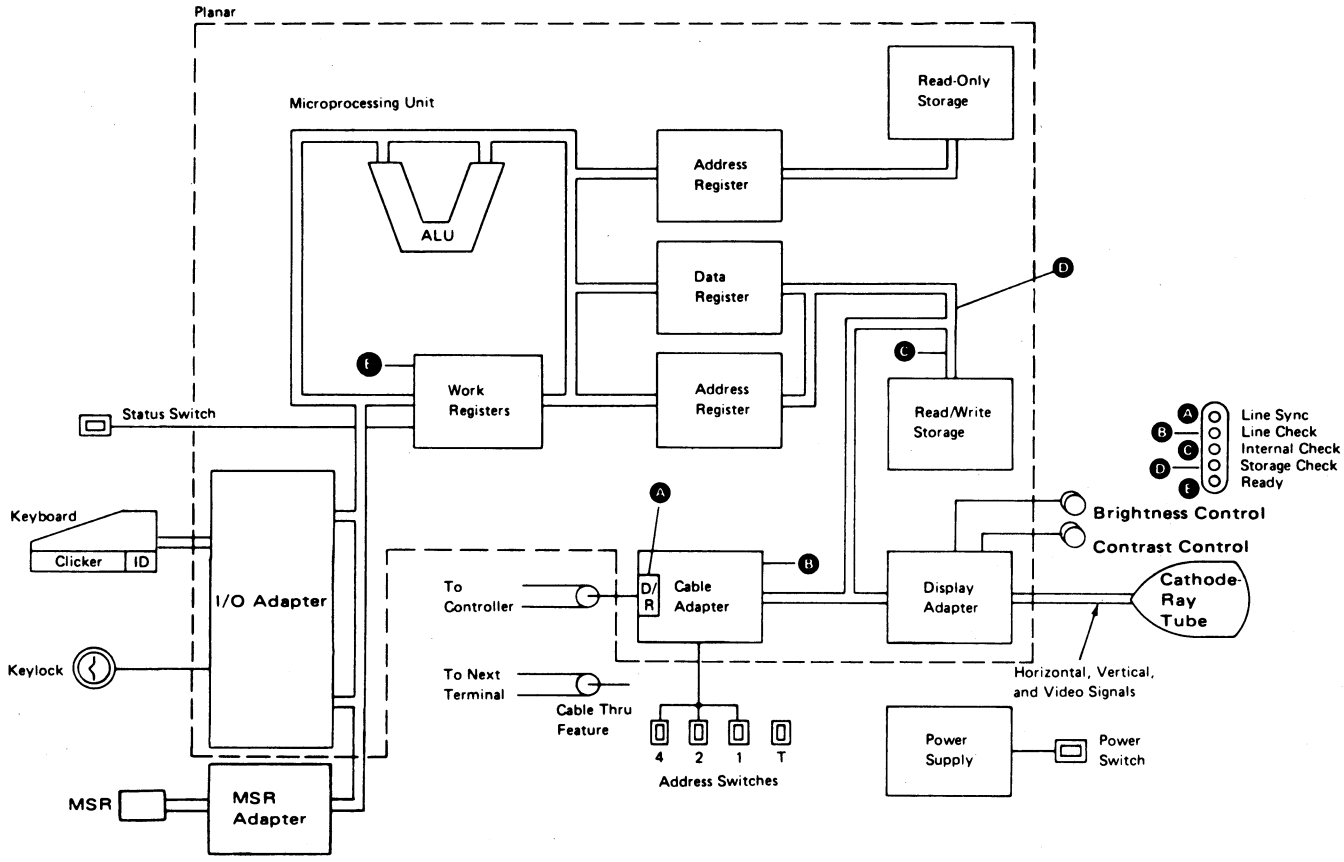
The major parts of the MPU are read/write storage and read-only storage, storage registers, work registers, and ALU (arithmetic and logic unit).

Read/Write Storage

Read/write storage is divided into two major parts; a display regen area and an I/O device control area. The I/O device control area is divided into three parts: display control area, cable adapter control area, and microprocessing unit work area.

Internal Processing Queue

Each display station has a work area in Read/write storage large enough to hold up to 16 frames of commands or associated data. Commands and associated data are executed from this work area; the commands and data that were placed in the work area first are the first to be used.



Control Registers

Each display station contains three registers that the controller can access. Each register is an address pointer. The registers are named the cursor, address counter, and the reference counter.

The cursor register controls the location of the cursor on the display screen. The address counter register is used to read and write data. The reference counter register is used for moving data from one display area to another.

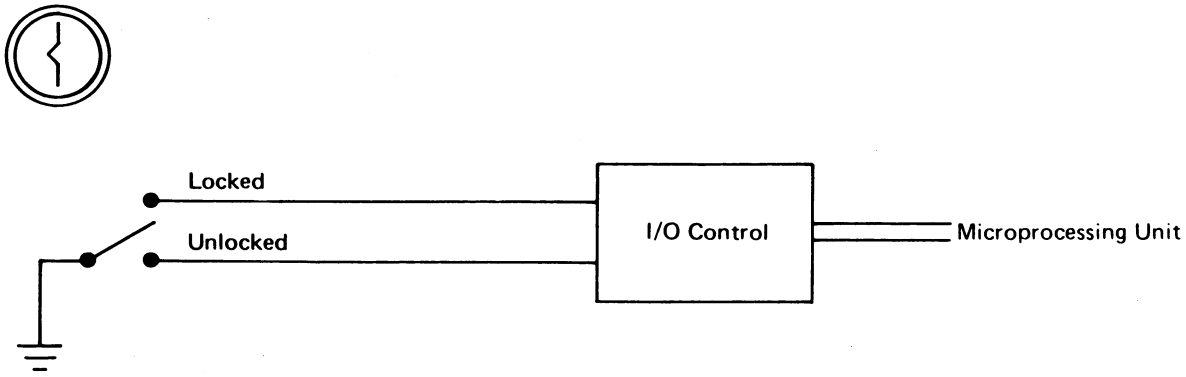
KEYLOCK FEATURE

A Keylock feature is available on the display station for security of data.

When the Keylock is in the locked position while the Status switch is set to the Normal position, the display screen is blank except for the system indicators on the right side of the screen. Data displayed at the time the Keylock is changed to the locked position is controlled by the application program. Keyboard data entered while the Keylock is in the locked position will not be displayed by the display station.

The Keylock feature can be in either the locked or the unlocked position, and the power-on diagnostic still functions the same.

Keylock

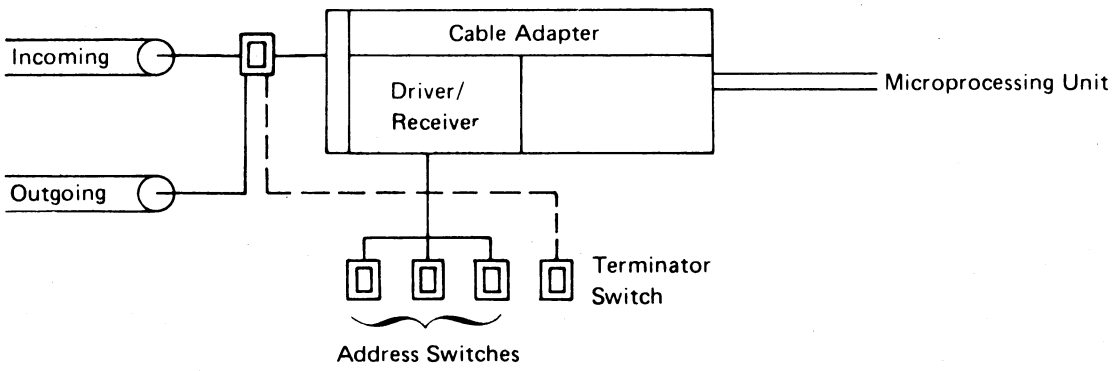


CABLE THRU FEATURE

If more than one work station (either a display station or a printer) is connected in series on the customer system cable, this feature must be installed on each of those work stations to supply connectors for the customer system cable to the next work station in the series. A maximum of seven work stations can be connected in this series. The last work station in a series does not require the Cable Thru feature. (A machine without the Cable Thru feature has a built-in termination and has a station address of 000.)

This feature has four switches. Three of the switches permit a unique address for the work station (addresses range from 000 through 110). The fourth switch permits termination for the last work station in the series. See the "Customer System Cable" section in this manual.

Note: Do not leave the system cable disconnected when servicing the display station with the Cable Thru feature. When this cable is disconnected, other devices are taken offline. A quick-disconnect adapter (IBM part 7362230 or an equivalent part) can be used to connect the system's incoming and outgoing cables; in this way, the display station is bypassed.



Address	Switch
0	000
1	001
2	010
3	011
4	100
5	101
6	110
7	Invalid

0 = Off; 1 = On

MAGNETIC STRIPE READER FEATURE

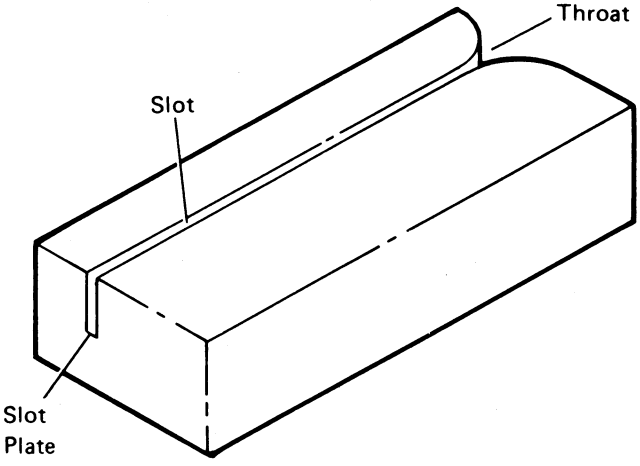
The Magnetic Stripe Reader (MSR) reads magnetic stripes on documents such as credit cards or identification cards. Reading of the magnetic stripe document is accomplished as follows:

Note: The MSR is positioned with the open portion (throat) of the slot towards the right.

1. The operator positions the document so that the magnetic stripe is at the bottom of the document and is facing the operator.

2. The document is inserted into the throat so that the bottom of the document is flush against the bottom surface of the slot plate.

3. The document is moved smoothly and continuously through the slot from right to left. The document must remain against the bottom surface of the slot.



The MSR can read documents from 0.178 to 1.143 mm (.007 inches to .045 inches) thick at a speed of 127.0 to 1016.0 mm (5 to 40 inches) per second. The MSR can read at any speed within this range; therefore, a constant speed through the slot is not necessary.

The MSR contains a document-sensing photocell, a reading head, and an amplifier. The photocell detects a document and readies the MSR adapter to receive the 5 bit (4 data bits and 1 parity bit) numeric data from the MSR. As the data is read from the document, it is stored in a buffer on the MSR card. Up to 128 bytes (125 data bytes plus the SOM, EOM, and LRC characters) can be stored. The MSR card circuits check for an error condition and set the error bit on in all data bytes if an error is found. Error conditions checked are:

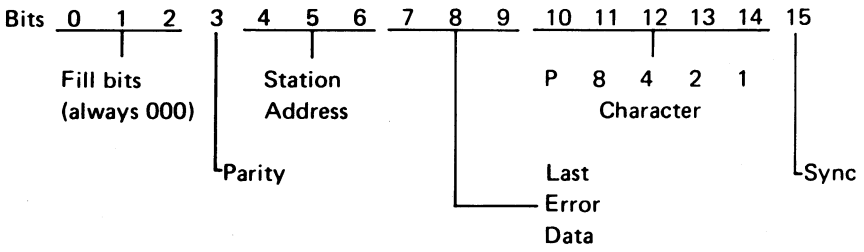
- No SOM, EOM, or LRC characters
- A parity error
- A speed check or LRC check error

The MSR card circuits then set the service request bit on. The MPU in the 5251, 5252, or 5255 Display Station sets the OS (outstanding status) bit on in the next poll response frame. The controller then issues a 'read MSR data' command to read 16 bytes of MSR data. If no error bit is on in the data received, the above ready sequence continues until all MSR data has been transferred to the controller. The MSR card circuits are automatically reset when the last data is read.

The controller then checks for a missing SOM, EOM, or LRC character, a parity error, or an LRC error. The MSR controller also checks to ensure the field is large enough to accept the data and that an operator ID is not being read into a field that is not specified for an operator ID.

When all the checking is complete and the MSR data is valid, the controller uses a 'write data and load cursor' command to transmit each byte of data to the display station. The display station loads the data into the regen storage area ready for the display. If an error bit is on in any data bytes received, the controller stops reading the data, resets the MSR card circuits, and displays the appropriate error code. If the controller detects an error after all data has been received, it discards the data and displays the appropriate error code.

Read Data Word



Bit 7
- 0 = Reader not installed
- 1 = Reader installed

Bit 8
- 0 = No error
- 1 = Reader error

Bit 9
- 0 = Not last character
- 1 = Last character

Valid Codes for the Character Field

Hex Code	Bits P	8	4	2	1	Character
0	1	0	0	0	0	0
1	0	0	0	0	1	1
2	0	0	0	1	0	2
3	1	0	0	1	1	3
4	0	0	1	0	0	4
5	1	0	1	0	1	5
6	1	0	1	1	0	6
7	0	0	1	1	1	7
8	0	1	0	0	0	8
9	1	1	0	0	1	9
A	1	1	0	1	0	:
B	0	1	0	1	1	% (start of message (SOM))
C	1	1	1	0	0	@
D	0	1	1	0	1	¬
E	0	1	1	1	0	=
F	1	1	1	1	1	? (end of message (EOM))

The first character sent in the read data/activate read command sequence is the SOM; it is followed by up to 15 data characters. If one of the read data words in this sequence does not contain EOM in the character field, the controller sends another read data command/activate read command sequence. After this command sequence has been received at the MSR, another 16 read data words are sent to the adapter. This sequence continues until the EOM occupies the character field of one of the read data words. When the EOM is sent to the adapter, an LRC (longitudinal redundancy check) character is sent in the next read data word to check the validity of the data transfer.

Eight read data/activate read command sequences are required to send the maximum of 128 bytes.

EXTENDED DISPLAY CHARACTER EXPANSION FEATURE

This is a half-planar electronic assembly containing an extension to the direct access (read-write) storage for alternate-entry or large-image ideographic symbols. It implements 448 characters as an optional feature; this is in addition to the 64 alternate-entry-character capability of the base machine.

The control of this assembly contains the following:

- Address control
- Data path control
- Clocking
- Refresh control

Appendix A. Display Station Setup

It is the customer's responsibility to set up the display station. If the customer requests setup aid, use these instructions.

Before the display station is shipped from the factory, it is fully tested and adjusted.

This setup procedure should be used after the display station has been located where it is to be used; this procedure should also be used whenever the display station is disconnected and moved.

DANGER
The display station has a weight of approximately 43 kilograms (95 pounds). NEVER LIFT IT WITHOUT AID.

If the display station has the Keylock feature, a small envelope containing 2 keys is fastened to the machine. Place the keys in a safe place; you will need one of them later in these setup instructions.

Before you start the setup instructions, ensure that a grounded power outlet is available.

If problems occur while you are following these instructions, go to the *Start-of-Call MAP*.

The setup instructions are written in two sections:

- You can complete Section 1 without connecting the display station to the system.
- Section 2 describes how to connect the display station to the system.

Setup Instructions — Section 1

1. Plug the keyboard cable into the keyboard cable connector.
2. Verify that the Power switch is in the Off position.
3. Verify that the Status switch is in the Normal position.
4. Plug the power cord into the grounded power outlet.
5. If the display station has the Keylock feature, insert the key and turn it clockwise to the Unlock (horizontal) position.
6. Set the Power switch to the On position and turn the Brightness control fully clockwise.
7. When the display station warms up (about 20 to 30 seconds), slowly turn the Brightness control counterclockwise to an acceptable brightness.

The following conditions indicate that the display station is working correctly:

- The cursor is in the upper right corner.
- A line is to the left of all the display screen indicator legends.
- The Ready light is on and all other lights are off.

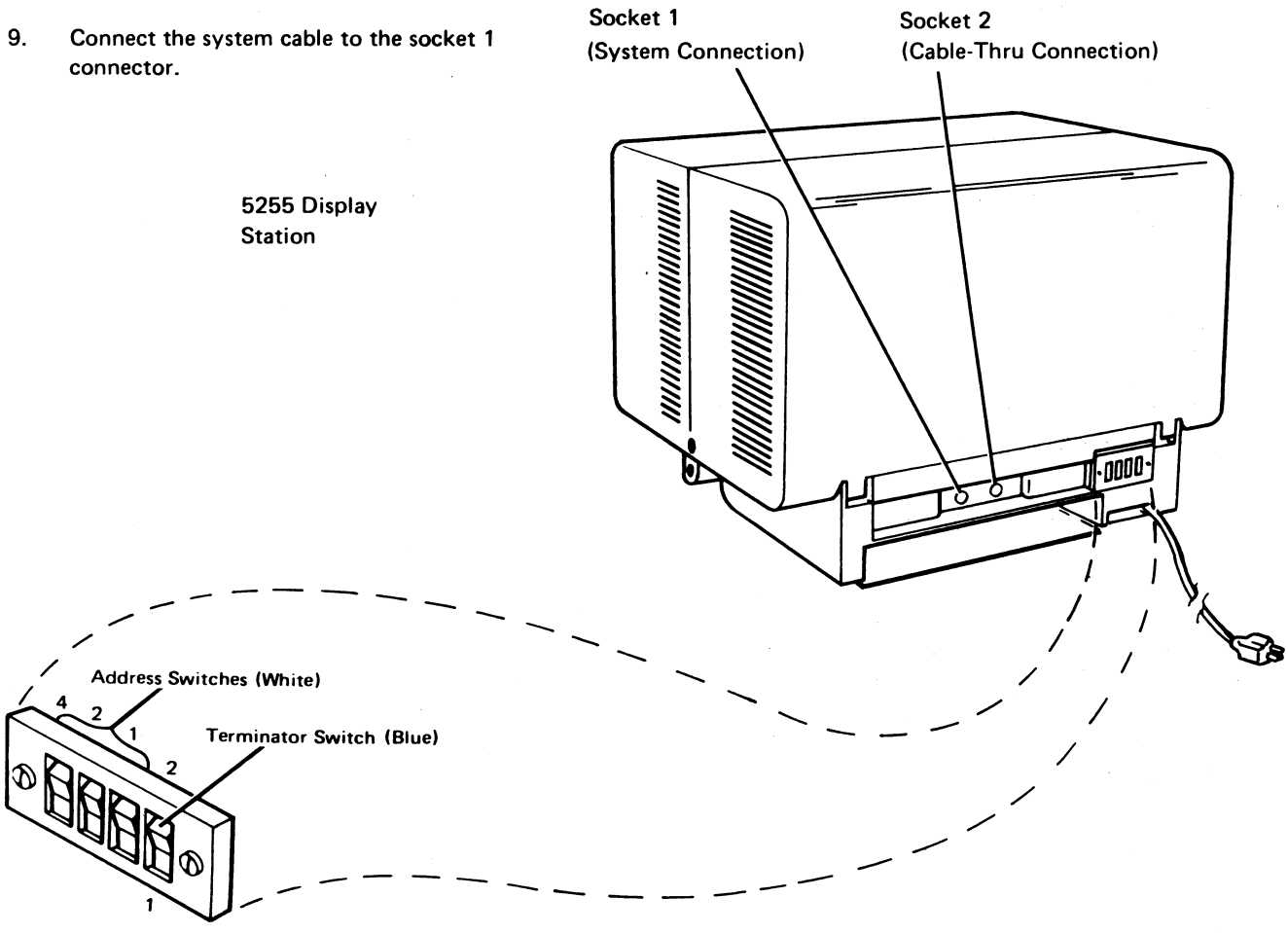
Setup Instructions — Section 2

Before you start connecting the display station to the system, ensure that the following is complete:

- The system operator knows that you are going to connect the display station to the system.
- The system cable (with a suitable connector) is installed and ready to use.
- The system cable is connected to the system.
- If the display station is to be connected in series by means of the Cable Thru feature to a preceding display station or printer, the Terminator switch on the preceding work station must be set to position 2 (171).

8. Set the Power switch to the Off position.

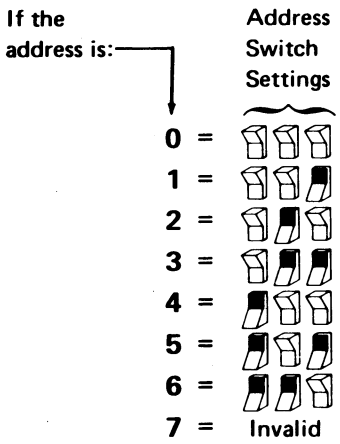
9. Connect the system cable to the socket 1 connector.



Note: If your display station has the Cable Thru feature go to step 10. If not, go to step 12.

10. Contact the system console operator for the address of this display station. Set the address switches:

    Use this table to determine the setting of the three address switches:



11. Set the terminator switch:

Position 1 stops the communications signal and completes the electrical circuit. Position 1 is the required position when the display station is the last work station on the line.

Position 2 allows communications signals to flow through the display station to the next work station.

12. Set the Power switch to the On position.

    The following conditions indicate that the display station is working with the controller:
    a. The cursor is in the upper left corner.
    b. The System Available indicator is on.
    c. The Line Sync light is on.
    d. The Ready light is on.
    e. The three check lights are off.

    If the display station has the conditions described in step 7 but does not have the conditions described in this step, the system may not be powered up, running, or working properly, or your display station may not be in session with the system.

13. Alphanumeric Keyboard:

    Press any numeric or alphabetic keys and listen for the clicker sound as each key is pressed. Observe the cursor as each character is displayed; the cursor should move.

    Ideographic Keyboard:

    a. Press the A/N Mode key. Press any data keys in the four rows directly above the spacebar. Listen for the clicker sound as each key is pressed. Observe the cursor as each character is displayed; the cursor should move.
    b. Press the Ideo/ALT Key. Press any data key and hold it down. Press and release each of the shift keys. Observe the cursor as each shift key is pressed; the cursor should move.
    c. Press any shift key and hold it down. Press and release several data keys. Observe the cursor as each data key is pressed; the cursor should move.

14. If the Keylock feature is installed on the display station, give both keys to the customer.

Setup is complete.

Appendix B. Keyboard Function

The Alphanumeric Typewriter Keyboard is shown.

The following descriptions apply to all keyboards unless otherwise noted:

System Request/Attention Key

The upper shift function of the SYS REQ/ATTN key is used for signing onto the system.

The lower shift function of the SYS REQ/ATTN key is used to send an attention command to the system.

An attention command can:

- Temporarily stop the present display station activity and allow selection of a new activity.
- Notify the system that the display station is ready to select a new program or activity.
- Request that the keyboard be unlocked (after normal error recovery action has failed) so that data entry can continue.

Command Key

This key directs the system to disregard the normal function of the top row of keys and instead to perform the function assigned in the program. A keyboard template indicates to the operator the command functions assigned to the top row of keys.

Delete/Insert Key

The upper shift function of this key is used to delete data from the display screen. When the Delete key is pressed, the character above the cursor is deleted, and all characters to the right of the cursor (in the same field) are shifted one position to the left.

The lower shift function of this key is used to insert a character or characters into an existing input field on the screen without destroying data already there. New characters are inserted at the cursor position, and the data above and to the right of the cursor is shifted one position to the right for each character that is inserted. The cursor also shifts one position to the right.

Erase Input/Home Key

The upper shift function of this key erases data in all input fields that have been modified. When this key is pressed in a program formatted display, all fields into which data has been entered are erased. The cursor moves to the home position on the screen.

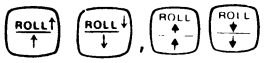
The lower shift function of this key moves the cursor to the home position of the formatted display. When the display station is in the free key mode, this function moves the cursor to the first input position in the upper left corner of the display screen.

Print Key

This key causes a print request to be sent to the system. The system program selects the printer that will be used.

Help Key

This key is used to display a description of a current error condition or to ask for further assistance from the system.

Roll Keys 

These keys move the information on the display screen either up or down.

Horizontal Movement Keys

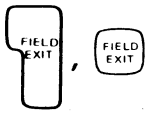
These keys cause the cursor to move one position in the direction indicated by the arrow on the key.

Error Reset Key

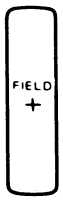
This key will unlock the keyboard when it is locked because of an error condition. It will also reset the insert, system request, and command modes.

Enter/Record Advance Key

This key indicates to the system that the entered data is ready to be sent.

Field Exit Key 

This key is used to exit from input fields. When this key is pressed, blanks are inserted from the cursor to the end of the field. When this key is pressed in a right-adjust field, the data to the left of the cursor is shifted to the right. The vacated positions are filled with zeros or blanks as specified by the format. This key must be used to exit from input fields that are specified by the program as right-adjust fields or field-exit-required fields.

Field + Key 

This key has the same function as the FIELD EXIT key and is for your convenience when you are using the 10-key numeric pad. The field-plus key is available on the typewriter-like keyboard only.

Field – Key

This key functions the same as the FIELD EXIT key except that it inserts a minus (-) sign in the last position of the input field. An error is displayed if you press this key in a field not programmed to accept negative numbers.

Dup Key

This key, in a field programmed to allow duplication, places an asterisk with an overscore($\bar{*}$) in the cursor position and in all the following positions of that field. This special symbol represents a request to the program to duplicate the information from the same field in the previous record or from another information source.

Character Backspace Key

This key moves the cursor back to the last (1-byte or 2-byte) character position into which a character can be entered. (This position is not necessarily the preceding position.)

Field Advance Key

This key moves the cursor to the first position of the next established field.

Field Backspace Key

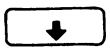
This key moves the cursor to the first character position of the field in which it is located. If the cursor is located in the first character position of a field when the key is pressed, it moves to the first character position of the preceding field.

New Line Key

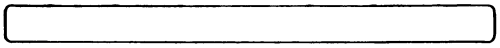
This key causes the cursor to move to the first character position of the first input field of the next line of the display screen. If the cursor is on the last input line of the display screen when this key is pressed, it moves to the first input position at the top of the display screen.

Upper Shift Key

When this key is pressed and held down, the alphabetic keys (A through Z) are entered as uppercase letters, the special characters identified on the tops of the numeric and symbol keys can be entered, and the function control keys on the left side of the keyboard can perform the functions shown on the top halves of the keys.

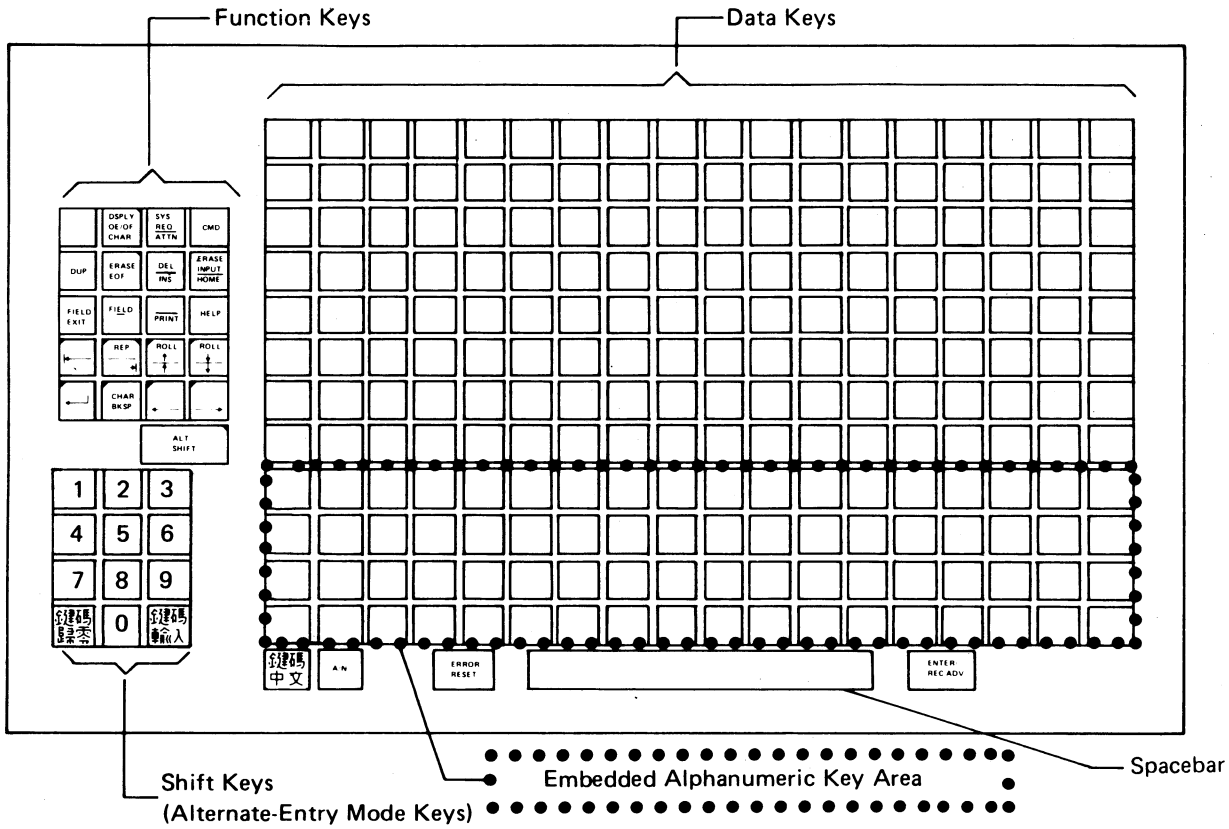
Shift Lock Key 

This key locks the keyboard in uppershift. You can return the keyboard to the lowershift by pressing either of the shift keys.

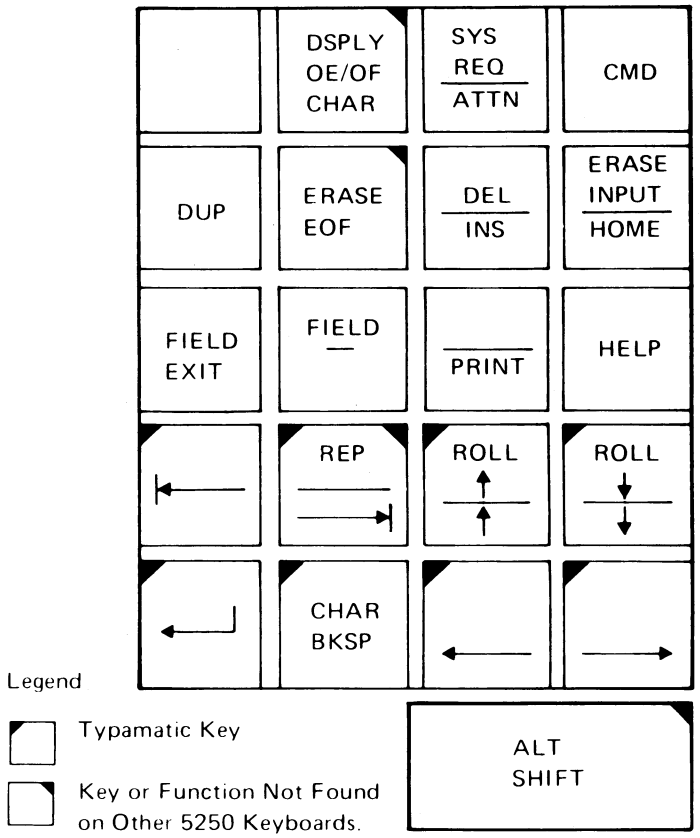
Spacebar 

This key moves the cursor to the right one position at a time. As the cursor moves, the data located above the cursor is destroyed, and a blank character is entered.

IDEOGRAPHIC KEYBOARD



The following figure shows the layout of the function control keypad of the ideographic keyboard:



The following function keys are found only on the ideographic keyboard:

Display Shift-Out Shift-In Character

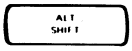
Causes shift-out (Hex 'OE') and shift-in (Hex 'OF') characters to be displayed on the screen.

Repeat

Causes the character preceding the cursor to be repeated at the current cursor location. The cursor then moves to the next character position.

Erase to End of Field

Causes nulls to be written from the current cursor location to the end of the field (alphameric) or to the next shift-in character (ideographic).

Alternate Shift 

Causes upper-shift function keys to be active. Also selects alternate entry mode when pressed concurrently with the ALT/IDEO key.

Alphanumeric Mode

Causes the keyboard to enter 1-byte mode. This activates the embedded alphanumeric area of the ideographic keyboard. In *either* or *open* fields, pressing CMD followed by the alphanumeric mode key sets the data type of the field to 1-byte data.

Alternate Entry or Ideographic Mode (ALT/IDEO)

Causes the keyboard to enter 2-byte mode. Pressing just this key activates ideographic keyboard mode, which allows the use of data-and-shift-key combinations. Holding down the ALT SHIFT KEY and pressing this key activates alternate entry mode, which allows the use of the shift keys in sequential entry of 2-byte characters. In *either* or *open* fields, pressing CMD followed by the ALT/IDEO mode key sets the data type of the field to 2-byte data.

Appendix C. Self-Check Feature

SELF-CHECK FEATURE

Self-Check is a feature of the host system and is included here only for reference. The Self-Check feature provides a way for the system to check the entry of data in fields that contain a precomputed self-check digit. The self-check digit is the last digit in the field and has been precomputed by either of two algorithms: modulus 10 or modulus 11.

Signed numeric, alpha only, numeric only, and alphanumeric fields can be specified for checking. All data is checked. The four low order bits are used when they are in the 0 through 9 range. If the four low order bits are in the A through F range, they are replaced by 0. Characters such as nulls or blanks are also treated as 0's.

Example:

Character	EBCDIC Representation	Four Low Order Bits Are Equal To	Number Used to Compute Check Digit
0	1111 0000	0	0
1	1111 0001	1	1
5	1111 0101	5	5
8	1111 1000	8	8
A	1100 0001	1	1
C	1100 0011	3	3
X	1110 0111	7	7
%	0110 1100	C	0
'	0110 1011	B	0

Computing the Self-Check Digit

Modulus 10

Modulus 10 can be computed for any field that is from 2 to 31 characters long. To compute the modulus 10 check digit, do the following:

1. Multiply the units position of the field (*not* the check digit) by 2. Multiply the tens position of the field by 1. Proceed to the high order position of the field; multiply alternately by 2 and 1.
2. Add the digits of the products.
3. Subtract the sum of the digits from the next higher number ending in 0.

The difference is the self-check digit.

Note: If the difference is 0, the self-check digit is 0. If the difference is 1, the character combination used in the self-check field has no check digit. Ensure that this character combination is not used in a self-check field.

Example:

Self-check field	A F 1 2 7 6 5
Multiplier	2 1 2 1 2 1 2
Product	2 6 2 2 14 6 10
Sum of the digits	2+6+2+2+1+4+6+1+0=24
Next higher number ending in 0	30
Subtract the sum of the digits	30–24=6
Self-check digit	6
Self-check field with check digit	A F 1 2 7 6 5 6

Modulus 11

Modulus 11 can be computed for any field that is from 2 to 31 characters long. To compute the modulus 11 check digit, do the following:

1. Assign a multiplier to each position of the field. Starting in the units position (*not* the check digit position) and proceeding to the high order position of the field, the multipliers are 2, 3, 4, 5, 6, 7, 2, 3, 4, 5, 6, 7, etc.
2. Multiply each character by its assigned multiplier.
3. Add the products.
4. Divide the sum of the products by 11.
5. Subtract the remainder from 11.

The difference is the self-check digit.

Note: If the remainder in step 4 is 0, the self-check digit is 0. If the remainder is 1, the character combination has no self-check digit. Ensure that this character combination is not used in a self-check field.

Example:

Self-check field	A F 1 2 7 6 5
Multiplier	2 7 6 5 4 3 2
Product	2 42 6 10 28 18 10
Sum of the products	2+42+6+10+28+18+10=116
Divide the sum by 11	116÷11=10 plus a remainder of 6
Subtract the remainder from 11	11−6=5
Self-check digit	5
Self-check field with check digit	A F 1 2 7 6 5 5

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